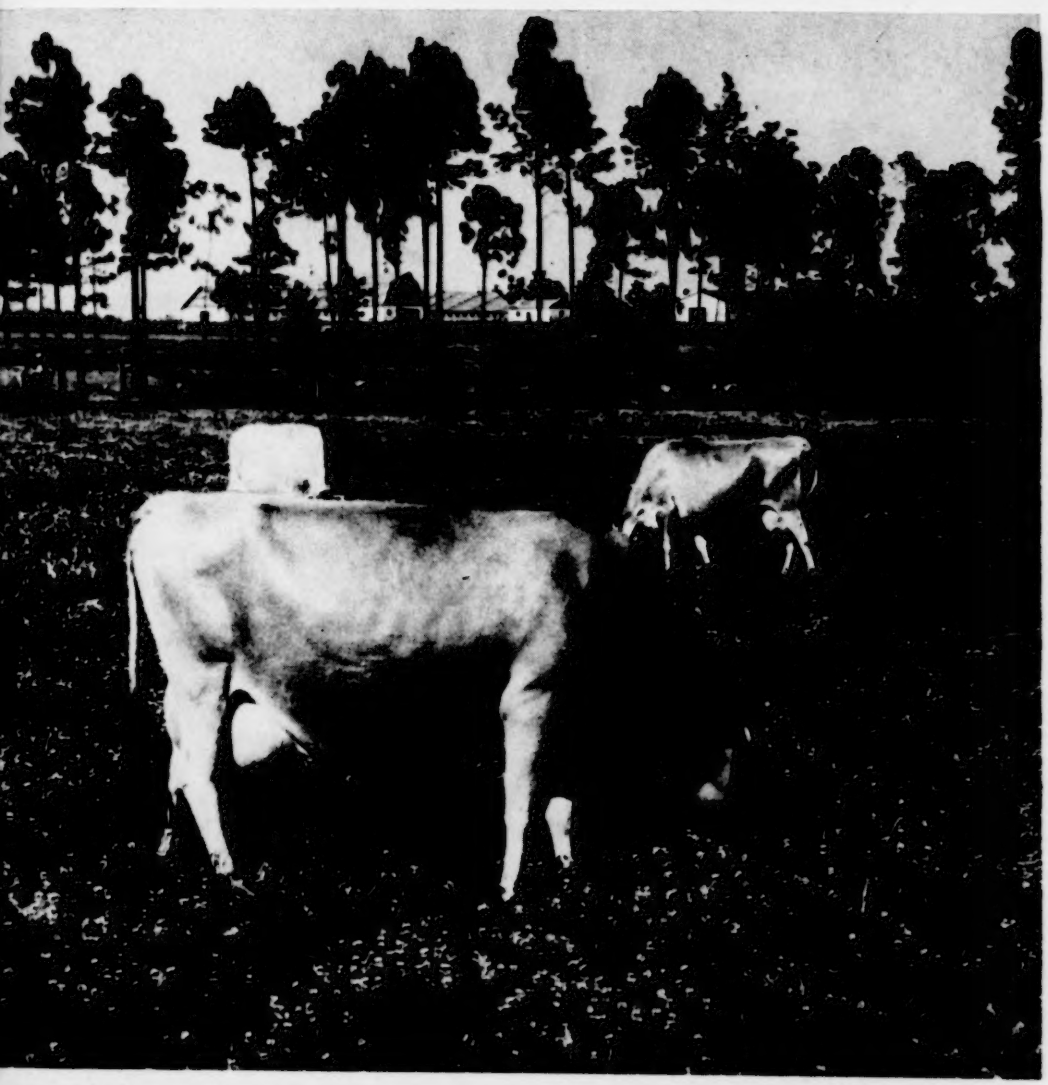

Volume 16, No. 4
July-August
1961

Erosion Control—
Problems and Progress

Fallowing for Wheat

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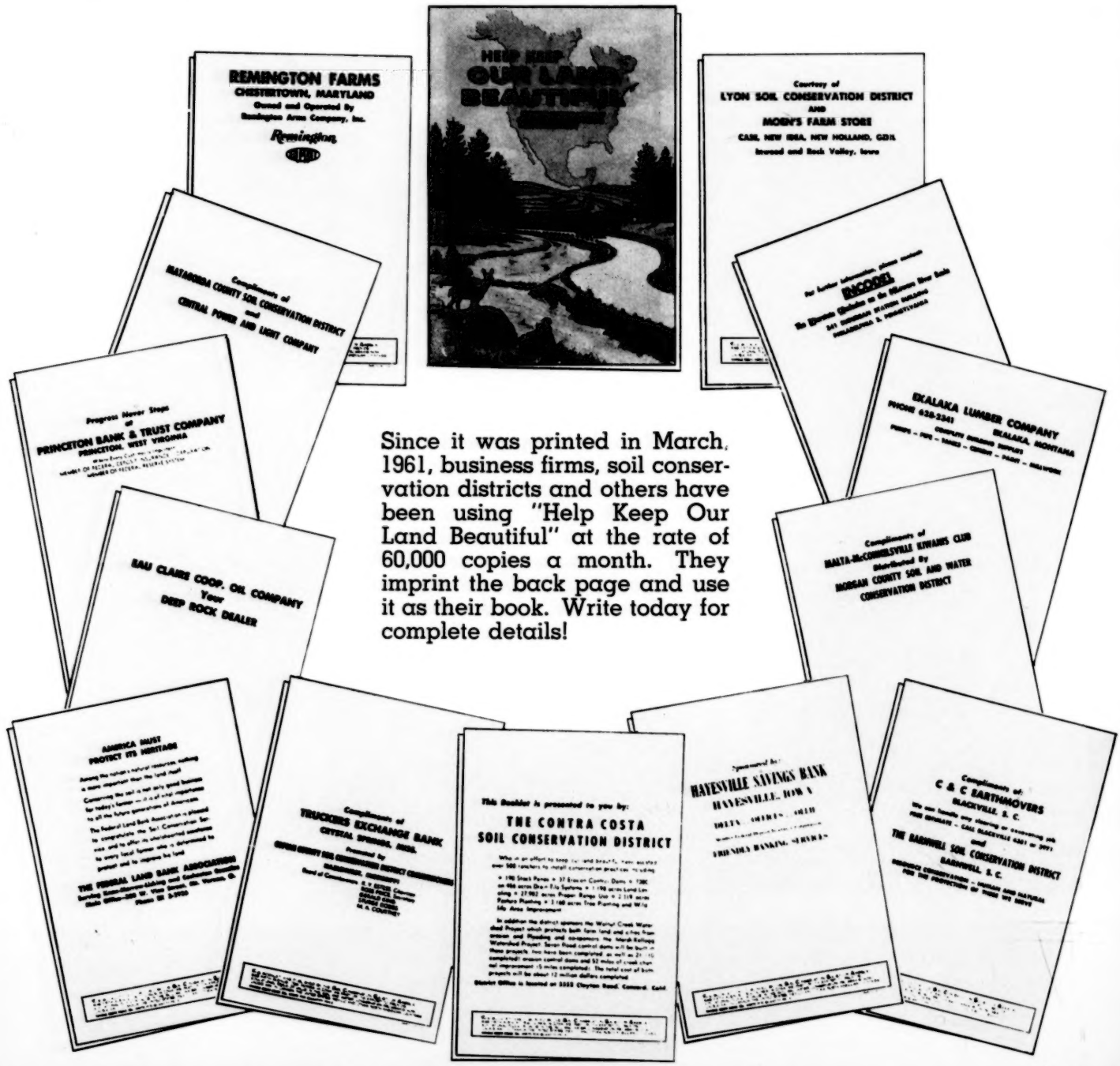

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JOURNAL OF SOIL AND WATER CONSERVATION®

July-August 1961 Volume 16 Number 4

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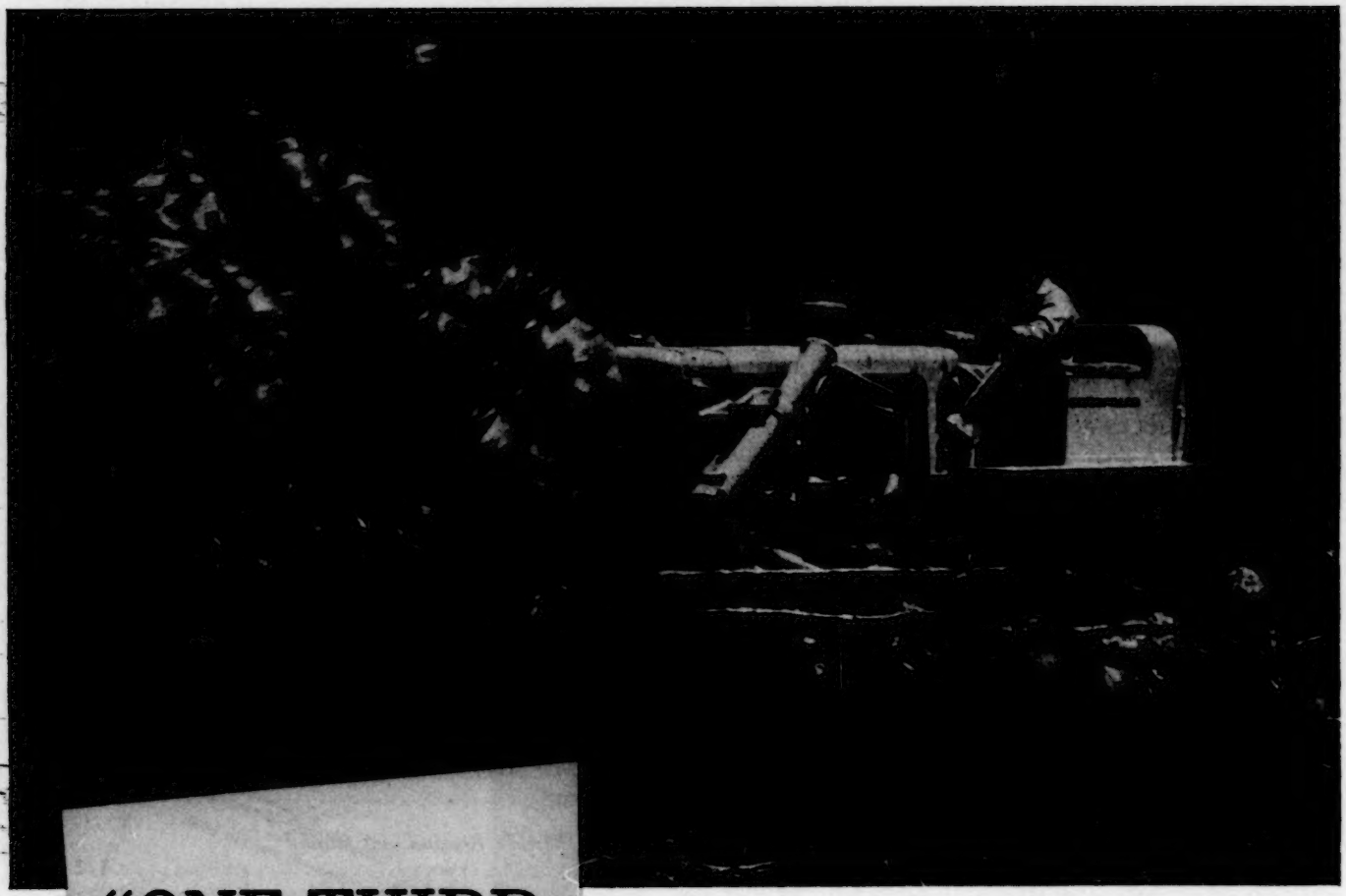

"ONE-THIRD more production from our new Cat D6B Tractor!"

THAT'S HOW E. R. MCCORMICK, Conservation Contractor, Covington, Tenn., rates his new series D6. Last season he traded his older Cat Diesel Tractors in on the new D6B and a D7. The trade-ins had about 8000 hours on their service meters. So he had a good and fair basis for comparison. Here is his statement: "We've used a Cat D6 Tractor and other models for a good many years. They've always given good service with very little down time. We've proven the new D6B to be the best ever, and figure we're getting one-third more production over our old D6. We especially like the real time savers on the new D6B—lifetime rollers, dry-type air cleaner—and the oil clutch, of course."

Mr. McCormick has singled out a few of the many advantages of his D6B. It used to take him 10–15 minutes to service a messy oil bath air cleaner. His dry-type air cleaner with reusable paper filter takes just 5 minutes to service.

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THE SOCIETY IN ACTION!

THE HONORABLE Orville L. Freeman, U. S. Secretary of Agriculture, has accepted the invitation of the program committee to speak at the *Society's* Sixteenth Annual Meeting. His appearance will mark the first time a Secretary of Agriculture has appeared on a *Society* program.

Arrangements have been made for the public to attend this session, as the local committee has scheduled the 6,000 seat Elliott Hall of Music on the Purdue campus for the Monday night meeting. The program will start promptly at 7:30 p.m.

Secretary Freeman has been working diligently, since taking office, on the administration's farm bill and on problems relating to the economic condition of agriculture. This will be one of his first major talks on conservation and one of his first appearances before a professional group. *Society* members in the North Central Region are acquainted with the Secretary's interest in soil and water conservation, demonstrated when he served as Governor of Minnesota.

Society members, who represent many facets of interest relating to land use, await with interest his statements on correlation of programs relating to conservation within the Department of Agriculture and with the Department of Interior. Most *Society* members are convinced the time has come when consideration must be given to studies such as the Conservation Needs Inventory, when new or revised programs relating to matters of land use are actuated. While Congress writes the legislation, leadership from the administration toward some of the goals long advocated by *SCSA* will prove helpful. Too many times in the past, the faithful conservation farmer or rancher has been penalized when emergency programs were adopted. And new programs have been established without taking advantage of existing programs that could be used as a starting base.

ONE OF THE MOST FREQUENT questions confronting those close to the *Society* building project, relates to "how are we doing?"

The answer—we are right on schedule. The cooperation and effort of *Society* members have been most encouraging. Never has a project been so well accepted and never have we had such an ambitious project—or such an important one. At this early stage the building is giving the *Society* an identity it has not previously known.

The location, on the property of Iowa State University; the enthusiasm and work of the building fund committee headed by Harold M. Rhodes; the work of the housing committee begun originally by J. S. Russell, and carried out during the past year by Frank H. Mendell; the special plans made by many chapters to secure their share of the funds for the project; the desire of individual members to make certain they own "a few bricks"—all of these factors point toward the desirability of the project in terms of benefit to the *Society*. Today the *Society* is better and more widely known than when the project started. It is recognized as a *Society* that is establishing a firm foundation for the future.

Right here in Des Moines many business leaders were not aware the *Soil Conservation Society of America* had its national office here, but now many are contributing to the project and will forever be cognizant of the *Society's* work.

Members from throughout the United States have stopped by this summer just to see the location. All of this indicates the widespread interest in a permanent home for the *Society*.

In 1959, when plans for a building were announced, the schedule called for completion within a period of 5 years. Two years have now passed. During this time the *Society* has secured a building site, employed an architect, selected a building style and by August 1, 1961, the architect will have completed blueprints. But most important of all, members and friends of the *Society* have contributed approximately $40,000 to the project (see page 195 of this issue of the JOURNAL). They have pledged much more. Thus, two-fifths of the scheduled time has elapsed, and two-fifths of the money is in the bank.

Yes, your *Society* is on schedule with its building project. Are you? Has your chapter made its quota? It is easy to do!

IN THE LAST ISSUE of the JOURNAL, announcement was made of several memorial funds established by friends of former *Society* members. This is a thoughtful gesture and demonstrates an abiding interest in the welfare of the *Society*. Just recently Mr. Clyde Spry, Secretary of Agriculture for Iowa, passed away. Mrs. Spry asked if it would be agreeable to the *Society* for her to announce that memorial contributions might be made to the *Society's* building project. Clyde, a 1960 Fellow of *SCSA*, was widely known throughout the United States and memorial contributions totaling several hundred dollars have reached the *Society* from many individuals, organizations, and groups with whom Clyde worked.

Spry was an outstanding leader in the soil conservation movement. He was a farmer member of the first State Soil Conservation Committee in Iowa and later served longer than any other man as Secretary of Agriculture for Iowa. He was a close personal friend and a valued counselor. Only a few months ago he was instrumental in securing final approval of the *Society's* lease for the building site.

A memorial within the *Society* is a fitting tribute to Clyde.

ALL REGISTRANTS at the annual *Society* meeting will receive in the mail, following the event, mimeographed copies of all papers made available by the speakers and committees. Members not at Purdue may secure copies of papers presented by writing to the Des Moines office of the *Society*, enclosing 25c for single copies or $1.50 for an entire set of papers We would appreciate your orders at this time so we may estimate the number of copies to reproduce. You may review the program in the March JOURNAL or the copy that was mailed to you with the annual ballot.

TEN YEARS AGO the Business and Organization Relations Committee saw the need for a series of booklets to tell the need for conservation programs to young and old alike. Working with the officers of the *Society*, this committee developed the booklet "Down the River" and introduced it at the sixth annual meeting in Memphis in 1951.

The sound foresight of members of this committee has been proven by the distribution of 3,754,000 popular-type booklets. In addition to this number printed by the *Society*, permission was recenty granted to an agency of the Government of Venezuela to reprint "Wonder of Water" for wide distribution in that country. Previously, "The Story of Land" had been printed in Spanish for distribution in Puerto Rico.

At one time it had been the intent to secure large distribution through purchases by national firms, but experience has shown that such firms frequently have their own materials, thus most purchases have been made by local business firms, soil conservation districts, state conservation departments, schools and other organizations. Many groups use the back page for imprinting their message.

One member of Congress used 50,000 copies in his successful campaign for re-election.

The number of the various booklets that have been printed is as follows:

"Down the River"	454,000
"Story of Land"	1,300,000
"Wonder of Water"	900,000
"Dennis the Menace and Dirt"	600,000
"Help Keep Our Land Beautiful"	500,000

"Down the River" is available now in revised form. This booklet relates land use to food and fiber production and suggests

(Continued on page 200)

Soil Erosion Control—Problems and Progress

MELVIN G. BLASE AND JOHN F. TIMMONS

In spite of substantial expenditures of public funds, control of soil erosion in western Iowa still falls short of the goals of public erosion control programs. The obstacles that prevent western Iowa farm operators from adopting erosion control practices are the subject of this article.

SEVERAL OBJECTIVES guided the analysis on which this article is based: (1) To learn how much progress farm operators were making in reducing erosion and in moving their own erosion control goals toward the public goal of reducing annual soil losses to 5 tons per acre; (2) to identify the obstacles preventing adoption of erosion control practices and to measure changes in obstacles over time; and (3) in view of the obstacles found, to examine present and proposed programs to reduce erosion.

The Land Use Laboratory

Research findings reported here are the result of investigations initiated in 1947 as a cooperative project of the Iowa Agricultural and Home Economics Experiment Station and the Farm Economics Research Division of the United States Department of Agriculture. This series of investigations has been termed "The Land Use Laboratory" of western Iowa, since periodically, studies are made into the processes of erosion control in the area composing the laboratory.

The laboratory is located in the Ida-Monona Soil Association in western Iowa (1). Approximately 5 percent of the land in the State is in this area. Ida and Monona soils constitute more than half the land in the Ida-Monona Soil Association. Both soils were formed from calcareous loess on hilly topography. The thickness of the loess ranges from a maximum of about 120 feet near the river valley, which is thought to be its source, to a thin loessial mantle in north central Missouri.

Ida and Monona soils are susceptible to erosion and drought. Measures that reduce runoff aid in minimizing both of these hazards. Without these practices, erosion proceeds rapidly through gullying, which, once started, is difficult to control. Partly as a result of erosion, fertility problems are more acute in this association than in most others in Iowa (5).

The modal erosion classes for Monona silt loam and Ida silt loam are 2 (moderate) and 3 (severe), respectively. The dominant slope group for Monona silt loam is 5 to 13 percent; the largest acreage of Ida silt loam occurs on slopes from 9 to 17 percent. Although the modal use-capability class for Ida and Monona soils is 3 (suitable for cultivation with complex or intensive practices), substantial acreages of Ida, Monona and terrace position Monona are in classes less suitable for cultivation.

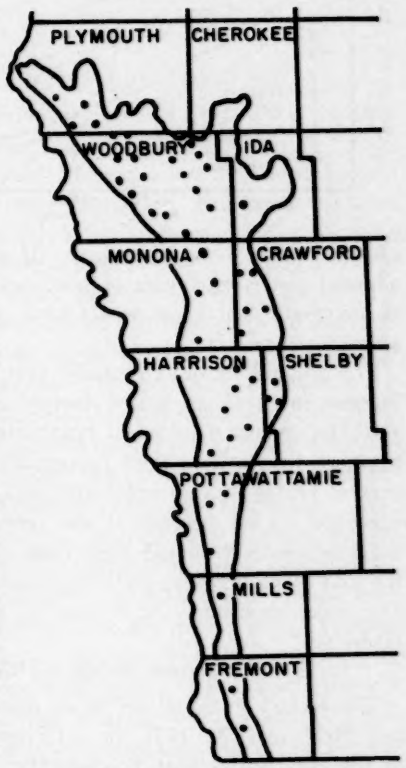

Figure 1. Western Iowa, showing the approximate location of the Ida-Monona Soil Association and the survey units in a sample of farms, 1957.

The agricultural economy of this area is predominantly feed-livestock production. This type of farming is based on intensive use of land for production of intertilled crops and this leads to high levels of soil erosion.

Initial Study—1949

The initial study in the Land Use Laboratory of western Iowa was made in 1949 by John C. Frey (2). He estimated the average annual soil loss on a sample of 144 farms in the Ida-Monona area in 1949 as 21.1 tons per acre. Eighty-nine percent of the farmers had not reduced their soil losses to the annual rate of 5 tons per acre, which is the goal used by public action agencies in the area. Also, 79 percent of the farmers had erosion control objectives that would allow soil losses

Melvin G. Blase, agricultural economist with the Economics Research Service, U.S. Department of Agriculture, headquarters at Iowa State University. He is now on military leave as a staff member of the Advanced School of Logistics, Air University, U.S. Air Force. John F. Timmons is professor of economics at the Iowa State University.

Several of the authors' co-workers made contributions to this study, particularly Virgil L. Hurlburt, Arnold A. Paulsen, Donald L. Osbun, and Walter R. Butcher. This article is Journal Paper No. J-3973 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project Number 1094.

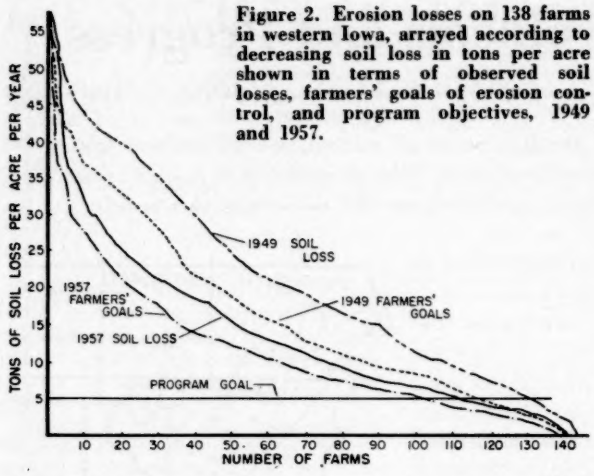

Figure 2. Erosion losses on 138 farms in western Iowa, arrayed according to decreasing soil loss in tons per acre shown in terms of observed soil losses, farmers' goals of erosion control, and program objectives, 1949 and 1957.

of more than 5 tons per acre. If these farmers had adopted the erosion control practices they believed to be necessary, soil losses would have averaged 16.4 tons per acre per year.[1]

Frey found four major obstacles that appeared to retard farmers in reaching desired erosion control objectives: (1) The change required in farm enterprises (primarily to more livestock) on 40 percent of the farms; (2) current rental arrangements and lack of landlord's cooperation on 34 percent of the farms; (3) mortgage indebtedness and annual fixed cash outlays for operating and living expenses on 30 percent of the farms; and (4) short expectancy of tenure on 19 percent of the farms (2).

Second Study—1952

The second study in this series was made by R. Burnell Held (3). In 1952, he interviewed the operators of the same farms that Frey used in 1949. Soil losses on the sample farms in the Ida-Monona soil area were estimated to have decreased 1.6 tons per acre between 1949 and 1952, but the average soil loss was still 19.5 tons per acre. As a group, the operators had not reached the goals of erosion control they had indicated in 1949; nor did they set goals in 1952 that were more ambitious than those set earlier. If they had used the practices they named as needed on their farms, the results would have been soil loss rates averaging 16.7 tons per acre.

Although the average soil loss changed little, there were noteworthy increases and decreases on individual farms. Of particular interest were the 36 farms on which

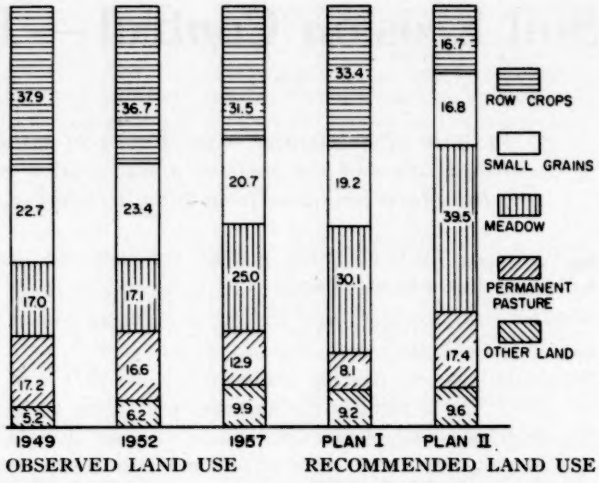

Figure 3. Percentage of total land in a sample of western Iowa farms in various uses, actual 1949, 1952, 1957, and use recommended by the Soil Conservation Service in 1957—Plan I (mechanical practice plan) and Plan II (high forage rotation plan).

the rates of loss were high in 1949 but on which, by 1952, the losses were lowered by 5 tons or more. Other farms showed increases in the rate of loss that were just as striking.

Held diagnosed the major causes for failure to reduce soil losses as uncertainty of tenure, lack of adequate finances, reluctance to assume risk, and lack of confidence in the recommended practices. The major causes of success in reducing soil losses from 1949 to 1952 appeared to have been increased appreciation of the seriousness of soil losses, increased security of tenure, and increased appreciation that shifts to more grass on the steeper slopes and to more forage-consuming livestock were conducive to erosion control and profitable farming over the long pull.

Third Study—1957

The third study in the series was made by the senior author of this article in 1957 to provide data comparable with the previous studies. Once more, operators of the same sample of farms were interviewed. In addition to obtaining farmers' reactions to erosion control plans, information was obtained about their use of land and characteristics of their farms. The nonoperating landowners of farms in the sample were interviewed also.

Many changes occurred on the sample farms between 1949 and 1957. Consolidation and division decreased the number of farms by 6, to 138 in 1957. Only 77 of the farms had the same operators in 1957 as in 1949. Fourteen operators had moved onto their farms between 1949 and 1952. The remaining 47 farmers had begun operation of their farms after 1952.

In 1957, the average soil loss estimated for the sample farms was 14.1 tons per acre. Had farmers

[1]Soil losses were computed using the system of factors designed by Browning which takes into account and weight various physical factors that affect erosion. These are soil type, crop management, vegetative cover (as expressed in terms of rotations), use or nonuse of contouring, terracing, strip cropping and listing, degree of slope, length of slope, extent of previous erosion and a constant term. The weight given each factor was based on experimental data for the particular condition found. The product of the factors represents the estimate of the amount of soil lost from an acre in one year with normal weather (4).

attained their goals of erosion control, the loss would have averaged only 11.7 tons. Thus, both the observed soil losses and soil loss rates given as farmers' goals decreased substantially between 1949 and 1957. A comparison of the observed soil losses and the farmers' goals in 1957 and 1949 is shown in figure 2.

The reduction in soil losses resulted from increased use of erosion control practices and from changes in land use. Table 1 shows the proportion of farms on which specific erosion control practices were used in 1949, 1952, and 1957. The greatest percentage changes during the period were in extent of terracing and construction of grass waterways. Figure 3 presents the proportion of land in the sample in various uses in 1949, 1952, 1957, and the proportion for various uses in two plans of use recommended by the Soil Conservation Service in 1957—a mechanical practice plan and a high forage rotation plan. There was a consistent decrease in proportion of land in row crops from 1949 to 1957.

TABLE 1
Proportion of Farms on Which Erosion Control Practices Were Used on at Least One Field, 1949, 1952, and 1957.

Practice	*Percentage of Farms on Which Practice Was Used on at Least One Field*		
	1949	*1952*	*1957*
	Percent	*Percent*	*Percent*
Grass waterways	33	46	72
Contouring	51	65	62
Commercial fertilizer	42	60	47
Terracing	15	27	40

Erosion Control Obstacles—1957

In the course of interviews during each of the three surveys, each operator of the sample farms was shown two erosion-control plans for his farm prepared for this study by the Soil Conservation Service—a mechanical practices plan and a high forage rotation plan. Between 1952 and 1957, the erosion control practices considered by soil conservationists as needed to achieve the 5 tons per acre soil-loss goal changed. Results of agronomic research at Iowa State University and other midwest experiment stations had shown that some practices were more effective and others less effective than was formerly believed. Table 2 shows that the percentage of all land in the sample recommended for row crops in the mechanical practice plan increased from 21.6 in 1949-51 to 33.4 in 1957. There was a corresponding increase in the percentage of small grains recommended and a decrease in the meadow and pasture recommended in the mechanical practice plans. There was little difference in recommended land use in the high forage rotation plans.

TABLE 2
Proportion of Acreage Recommended in 1949-1952 and 1957 by the Soil Conservation Service for Western Iowa Farms, by Types of Crops Under Two Kinds of Plans.

Land Use	*Mechanical Practice Plan*		*High Forage Rotation Plan*	
	1949-1952	*1957*	*1949-1952*	*1957*
	Percent		*Percent*	
Row crop	21.6	33.4	14.6	16.7
Small grain	15.9	19.2	15.5	16.8
Meadow	37.7	30.1	41.6	39.5
Permanent pasture	15.3	8.1	14.7	17.4
Other	9.5	9.2	13.6	9.6

During each interview, the mechanical practice plan and the high forage rotation plan were described in detail. The farm operator was then asked if there were obstacles that would prevent the adoption of practices recommended in either plan. In 1957, 16 obstacles were mentioned by the operators as factors that would prevent adoption of at least one erosion control practice. Table 3 shows the number of farmers who named specific ob-

TABLE 3
Number of Farm Operators Who Reported Obstacles to Individual Erosion Control Practices and Number of Farms on Which Each Obstacle Was Reported on 138 Western Iowa Farms in 1957.

Obstacle	*Number of Operators Who Reported Obstacles to Specified Practices*								*Number of Farms on Which Obstacle Was Reported*
	Contouring	*Terracing*	*Waterways*	*Fertilizer*	*Structures*	*Contour Fencing*	*Rotation I*	*Rotation II*	
Amount or kind of recommended practice	3	39	3	8	0	3	59	38	90
Need for immediate income	0	9	7	25	6	1	9	47	70
Insufficient roughage consuming livestock	0	0	0	0	0	1	15	49	51
Failure to see the need for recommended practice	12	31	9	16	1	18	0	0	47
Custom and inertia	6	14	3	10	0	1	18	10	33
Rental arrangement and lack of landowner's cooperation	2	16	4	6	2	1	4	10	25
Field and road layout	10	5	0	0	0	13	2	2	22
Lack of adequate machinery and power	5	10	0	0	0	0	1	3	17
Short expectancy of tenure	3	5	3	10	3	5	3	3	12
Lack of cooperation of neighboring farmers	0	1	10	0	1	0	0	0	12
Terrace design	0	10	0	0	0	0	0	0	10
Small size of farm	0	1	0	0	0	0	3	9	10
Lack of adequate labor supply	0	1	0	0	0	3	1	3	8
Risk and uncertainty	0	1	0	3	0	0	0	5	8
Lack of adequate buildings	0	0	0	0	0	0	0	4	4
Inability to shift erosion loss	1	0	0	0	0	0	0	0	1

stacles to particular practices, and the total number of farms on which each obstacle was mentioned.

The relationships between the obstacles named and soil losses in 1957 were examined by means of multiple variable linear regression. Results of this procedure indicated four main obstacles to reduction of soil losses: (1) Need for immediate income, (2) failure to see the need for a recommended practice, (3) custom and inertia, and (4) field and road layout. These obstacles and others were examined in detail to determine the reasons for their existence, and to find possible remedies.

Need for Immediate Income

Need for immediate income constituted an obstacle for two basic reasons. One was the large out-of-pocket expense involved in adopting some erosion control practices. The other was the opportunity cost; that is, the income that operators believed they would have had to forego if they had adopted the recommended erosion control practices.

In table 4, farm operators are grouped according to the percentage change in gross returns they anticipated 1, 5 and 10 years after the adoption of Plan I, the mechanical practice plan. Farm operators were not optimistic about increasing their gross returns as a result of this plan. There was evidence of a substantial lack of knowledge about the change that erosion control practices could be expected to make in their gross farm incomes.

TABLE 4
Number of Operators Who Estimated Specified Percentage Changes in Gross Returns to Their Farms from the Adoption of Plan I, 138 Sample Farms in Western Iowa, 1957.

Percentage Change in Gross Returns	*Number of Operators Estimating Specified Percentage Change in Income After*		
	1 year	*5 years*	*10 years*
	Number	*Number*	*Number*
Minus or none	71	32	28
1 to 33 percent increase	28	59	54
34 to 66 percent increase	4	10	16
67 percent increase and over	0	2	4
No estimate given	35	35	36

Farm operators were more pessimistic about the effects on their gross farm income of plan 2, the high forage rotation plan (table 5), than about those from Plan I. However, the number of operators expecting a decrease in their gross income, or no change, tended to decrease with time after the practices were adopted.

TABLE 5
Number of Operators Who Estimated Specified Percentage Changes in Gross Returns to Their Farms from the Adoption of Plan II, 138 Sample Farms in Western Iowa, 1957.

Percentage Change in Gross Returns	*Number of Operators Estimating Specified Percentage Change in Income After*		
	1 year	*5 years*	*10 years*
	Number	*Number*	*Number*
Minus or none	82	66	63
1 to 33 percent increase	15	31	30
34 to 66 percent increase	3	3	6
67 percent increase and over	1	1	1
No estimate given	37	37	38

Farm operators in the sample had little knowledge of projected costs of adopting soil erosion practices. In the course of the interview, each farm operator was asked to estimate the costs of erosion control practices in the mechanical practice plan. A majority of the operators had no idea of the expected costs. Of those who estimated the cost, three-fourths overestimated it relative to a budgeted cost based on data obtained from Soil Conservation Service personnel in the area.[2]

Another indication of operators' expectations of the profitability of control practices was that they rated erosion control practices relatively low as either a first or second investment preference. Self-rationing of capital prevented most operators who needed to borrow funds for erosion control practices from doing so. The uncertainty of income from these practices was the reason most frequently mentioned for unwillingness to borrow.

Many owner-operators thought investments in erosion control practices would not increase the value of their farms. This belief was confirmed by analysis by multiple linear regression of the relationships between changes in land values and changes in soil loss from 1949 to 1957. For a subsample of farms, the regression coefficient indicated that changes in erosion did not explain statistically significant amount of change in land values.

Failure to See the Need for a Practice—Custom and Inertia

Because of the similarity of the obstacles of failure to see the need for an erosion control practice and of custom and inertia, the two were combined as one obstacle. Operators' responses to this obstacle were not as explicit as they were to others. They included such statements as: Contouring not needed, terraces too difficult to farm, waterways and commercial fertilizer not needed, and contour fencing not wanted. Some operators said they just did not want to change their established methods of farming.

Field and Road Layout

Because of the difficulties of farming rectangular fields on the contour, the importance of field and road layout as an obstacle seemed to increase with recommendations for more contouring and terracing in the area. Many farm operators said they would adopt terraces if they could be laid out in parallel fashion.

Other Obstacles

Several other obstacles, although not statistically significant, were important because they were interrelated with obstacles that were significant. To the question of whether amount or kind of a recommended practice was an obstacle, typical responses included objection to the

[2]The cost estimate excluded that part of the cost which would be covered by incentive payments from the Agricultural Conservation Program if the operator were a cooperator.

number of terraces, too much corn or corn several years in succession in rotations in the mechanical practice plans, or lack of enough corn in the high forage rotation plans. Reasons given for such responses were that: (1) The operator did not share the public goal of reducing soil loss to 5 tons an acre, (2) he would have approved an intermediate erosion control plan rather than either of the extreme plans presented to him, or (3) more erosion practices were recommended in his plan than he thought were necessary to reduce erosion to the 5-ton goal. Evidence indicated that, in many instances, the latter judgment was correct.

Two other important obstacles were lack of sufficient roughage-consuming livestock, and rental arrangement combined with lack of landowner's cooperation. The former obstacle was closely related to the need for immediate income, and often included dislike for the kinds of livestock necessary to utilize the forage produced in the erosion control plans. The landowner's failure to cooperate resulted either from his need for immediate income, his lack of interest in the farm, or his expectancy of owning the farm for a short time.

Characteristics of Farm Operators and Their Farms

In addition to the obstacles mentioned by the operators, relationships between characteristics of their business and soil erosion were analyzed. It was found that soil losses were significantly lower on farms on which the operators participated in soil conservation districts and higher where they did not participate. Also, soil erosion was lower on farms on which the operators recognized the seriousness of the erosion problem. More soil was conserved on farms on which the operator worked at some nonfarm job, thus relieving the pressure for immediate income. Soil losses were higher on farms with large natural erosion hazards than on those without this problem. Finally, soil losses were significantly lower on farms on which the operators were willing and able to borrow funds to install erosion control practices.

Obstacles of Nonoperating Landowners

The earlier inquiries by Frey and Held indicated that the lack of landowners' cooperation was an obstacle preventing the adoption of erosion control practices on some tenant-operated farms. In reality, obstacles named by tenants and by nonoperating landowners function simultaneously to prevent the adoption of erosion control practices. Therefore, nonoperating landowners (owners of tenant-operated farms) in the sample were interviewed in 1957. The procedure for obtaining and analyzing the data was similar to that used for the farm operators.

The obstacles given by nonoperating landowners were similar to those mentioned by the farm operators. The most frequently occurring obstacles were (1) amount or kind of recommended practice, (2) need for immediate income, (3) failure to see the need for a recommended practice, and (4) insufficient roughage-consuming livestock. The second and fourth obstacles (closely related to soil loss in a statistical sense) were most frequently given.

Characteristics of Tenant-Operated Farms and Landlords

The regression of several characteristics on soil loss explained a significant amount of variation in soil losses on tenant-operated farms. The independent variables with statistically significant regression coefficients were (1) acres of additional land owned, (2) expectancy of continued ownership of the farm, (3) need of owner to borrow funds for erosion practices, and (4) operator's need for immediate income. These characteristics were considered to be the most closely related to soil losses through, or in addition to, owners' and operators' obstacles.

Landlords who were certain of owning the farm 1 year after date of interview had lower soil losses. Soil losses tended to be lower on farms owned by individuals who had additional farms. They tended to be high on farms whose owners needed to borrow funds to install erosion control practices and whose tenants named as an obstacle the need for immediate income.

Possible Remedies

As a result of this series of studies, we suggest several possible approaches for overcoming obstacles to erosion control. Three alternative courses of action—education, additional research, and direct public action—were considered in developing these suggestions.

▶ *Education and Research*

Additional education about the seriousness of the erosion problem, directed particularly toward nonoperating landowners, is needed to overcome custom, inertia and failure to see the need for erosion control practices. To increase farm operators' and landlords' knowledge of the profitability of erosion control practices, a more broadly directed educational program should stress the costs and returns associated with these practices. With a better basis for appraisal of the profitability of conservation practices, fewer farmers might have been concerned about reduction in immediate income. In addition, the importance of this obstacle would be lessened by dissemination of information concerning the advantages and methods of including the costs of erosion control practices in long-term loans.

Educational programs directed particularly toward owners and operators of tenant-operated farms should emphasize the profitability of livestock, crop-livestock share leases, and methods of incorporating compensation clauses in leases.

Information is needed about methods, appraisal and purchasing arrangements for transfer of small tracts of land that could be farmed on the contour more easily by neighboring farmers than by present owners. Also, educational activities constitute a prerequisite for revision of real estate tax rates to correspond with land capability.

Expanded Extension Service and soil conservation district programs could facilitate these educational efforts. Farm operators indicated that one of the most acceptable methods of receiving such information was through neighboring farmers who are community leaders.

Extended Farm Planning and Research Needs

The objections to the choice and amount of a recommended practice indicated that additional effort should be made to make erosion control plans more acceptable to farmers. This could be done by making them more comprehensive—economic as well as physical considerations are essential. The need for revision of plans for the sample farms, and the desire of many operators to adopt practices slowly over a long period of time showed that farm plans need to be flexible and dynamic.

The accuracy, completeness, and low cost of budgeting with electronic computers recommend it as a possible method of enlarging the amount of soil erosion control farm planning. A successful computational service for farm planning might require personnel in action agencies to work with farm operators in obtaining the necessary data and interpreting the results. If required data were made available, the capacity of electronic computers to handle large volumes of data would make possible the revision of farm plans as the need arose.

Further Research Needs

Further research analysis is needed to develop an estimate of future land use by areas in the United States to serve as a guide in determining the total amount of soil erosion control needed, as well as the particular practices that would be consistent with the economic advantage of each area. The growth of surpluses and the need for immediate income indicate that this information is needed by public agencies and individual farmers as a focal point in making long-range plans.

Federal agricultural programs such as price supports and the soil bank also need to be analyzed with respect to their expected effects over time on erosion control.

Before educational programs that relate to the profitability of erosion control practices can proceed far, additional and better information about costs and returns of erosion control practices will be needed.

The obstacle of field and road layout suggested that further research is necessary to determine methods of modifying some erosion control practices. Farm operators frequently stated that terraces would be acceptable if they were laid out in parallel fashion. Research concerning the physical possibility and economic feasibility of parallel terracing and cut-and-fill terraces may provide information for educational programs that will help to overcome this obstacle. An inquiry into the economics of land-forming practices, currently in process, will provide some insight into this problem.

Emphasis is needed on the effects of erosion control practices on land prices. Findings of this series of studies about obstacles to erosion control in western Iowa indicate that obstacles change over time. Consequently, continuing analysis of problems and development of remedies for the obstacles will be needed in the future.

Other Public Action

Additional research, particularly that concerned with estimating costs and returns of erosion control practices, may reveal that individual landowner's interest in erosion control fall short of public interests to such an extent as to warrant an increase in or revision of incentive payments for some erosion control practices. Incentive payments seem justified only for those practices which are in the public interest but are not profitable to individual farmers. For instance, incentive payments appear to be justified as part of the remedy for the obstacle of field and road layout. In 1957, the Crawford County Agricultural Conservation Program made incentive payments for changing fences to conform to the contour. Facilitation of erosion control and the inadequacy of economic incentives for individuals to undertake the practice justified this use of Federal funds.

The Conservation Reserve Program facilitated continuous forage production on many farms between 1957 and the program's termination in 1960. A more permanent shift in the use of land might be obtained through land use easements. Under a land use easement program, landowners would have the opportunity to sell to the Federal Government their rights to produce specified crops. In areas with great erosion hazards like those in the Ida-Monona Soil Association the Government might purchase the rights to produce all except forage crops. Such a program would facilitate both control of soil erosion and control of production of surplus crops.

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Fallowing for Wheat Production

J. J. BOND, C. E. VAN DOREN, AND T. J. ARMY

Summary

Three methods of fallow for winter wheat production on medium- to fine-textured soils of the southern Great Plains were evaluated in relation to moisture storage, soil organic matter, grain yields, and erosion control. Fourteen years of crop data showed that yields on early and delayed stubble-mulch fallow were similar. Yields with one-way disc plowing, early fallow, averaged about 2 bushels less than yields with either of the stubble-mulching systems. Delayed stubble-mulch fallow usually contained somewhat more soil moisture at seeding than did the two methods of early fallow. Delayed stubble-mulch fallow reduced losses of organic matter and nitrogen and improved wind erosion protection.

All results indicate that the incorporation of delayed fallow should be considered in dryland wheat-fallow systems on the medium- to fine-textured soils of the southern Great Plains.

WHEAT HAS BEEN GROWN on fallow in the more arid sections of the Great Plains since the beginning of the 20th century. However, the use of an alternate crop-fallow system received its greatest emphasis during the drought of the mid-thirties (6). In the southern Great Plains States of New Mexico, Oklahoma, and Texas there was an estimated 2.4 million acres of summer fallow in 1954 (8). Experience has demonstrated that in the drier areas of the Great Plains the most effective utilization of equipment and labor is obtained when summer fallow is employed (5).

In the Great Plains areas of New Mexico, Oklahoma, and Texas, wheat yields following summer fallow have averaged about 40 percent greater than yields with continuous cropping (6). The yield increases attributable to a preceding fallow period, however, were related to soil type and moisture supplies. Recently reported results indicate that the use of summer fallow in dryland wheat production materially reduces the frequency of crop failures and adds stability to farming operations in the southern High Plains (1).

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The Texas Agricultural Experiment Station cooperated with the Agricultural Research Service on the study reported here.

Although the use of summer fallow is a partial insurance against crop failure, the land is usually left void of growing vegetation during all or part of the fallow period and without plant cover, wind erosion is always a hazard. During and subsequent to the severe dust storms of the thirties, various implements which left residues as well as clods on the surface were designed for cultivation during the fallow period. The moldboardless plow and the Noble blade were two implements which replaced the regular moldboard plow. In the central and southern Great Plains, the one-way disc also came into prominence, not as an implement to control erosion, but as a cheap, fast and effective implement for seedbed preparation. The one-way disc practically displaced all other types of tillage equipment. Repeated use of this implement on soils with scanty residues was largely responsible for the extensive soil blowing in the central and southern winter wheat regions in the mid-thirties (6). Nevertheless, the one-way disc is still used widely in continuous cropping and wheat-fallow systems throughout the southern Great Plains.

Regardless of the tillage implement used, cultivation during the fallow period always reduces the effectiveness of plant residues in controlling wind erosion. A minimum of tillage during the fallow period is, therefore, desirable. A delayed fallow system whereby the land is left undisturbed from harvest time until the following spring has been found to be a successful practice for wheat production in many areas of the Great Plains (2, 4, 7). The absence of tillage until the following spring usually results in a moderate to heavy growth of weeds and volunteer wheat which form a protective surface cover for wind erosion control.

It was the purpose of these studies to evaluate three widely used methods of fallow in terms of effects on: (1) Moisture storage, (2) organic matter and nitrogen, (3) erosion control, and (4) crop yields on the medium- to fine-textured soils of the dryland wheat areas in the southern Great Plains.

Experimental Procedure

As a part of a larger research program in dryland agriculture, experiments have been conducted at the Southwestern Great Plains Field Station to evaluate three methods of fallow for winter wheat production: (1) One-way tillage, early fallow, (2) stubble-mulch tillage, early fallow, and (3) stubble-mulch tillage, delayed fallow. One-way tillage was performed with a one-way disc plow. Stubble-mulch tillage in both early and delayed fallow

was accomplished exclusively with 30-inch sweeps mounted on a heavily reinforced carrier equipped with power lifts and rolling coulters. With early fallow, all weed and volunteer crop growth was controlled from harvest until wheat seeding time approximately 16 months later. In delayed fallow, no tillage was performed from harvest until weed growth began the following spring.

Experiments were initiated in 1941, and the first crop data were obtained in 1943. Supplementing soil information was obtained periodically during the complete period of experimentation. Varieties of wheat used were as follows: Tenmarq, 1943-1946; Westar, 1947-1952; and Concho, 1953-1956. All plots were one-third acre in size. There were four replications from 1943 to 1949 and two from 1950 to 1956. Each year, approximately 30 pounds of seed per acre was planted in 14-inch rows with a shovel type drill.

The deep, slowly permeable soil of the experimental area is classified as Pullman silty clay loam. It is representative of some 12 million acres of medium- to fine-textured soils commonly referred to as the "hardlands" of the southern High Plains. The Southwestern Great Plains Field Station is near the center of these "hardlands." Characteristics of a Pullman profile have been described by Coover et al. (3).

Organic matter analyses were made by the wet combustion method using orthophenanthroline as an indicator (10). Total nitrogen analyses were made by the Kjeldahl method. A representative portion of each plot was harvested for yield determinations. Soil moisture was determined gravimetrically.

Soil Moisture

Previous results (4) and field observations have shown that with delayed fallow, uncontrolled crop and weed growth following harvest depletes soil moisture. Moisture measurements made after the first summer of fallow in 1943, 1947, and 1949 revealed that the delayed fallow plots contained an average of 1.0 inch of available soil moisture while the early fallow treatments contained an average of 1.4 inches. There were no measurable differences in moisture storage in the early fallow systems.

One of the most valuable criteria for evaluating fallow practices is the amount of stored soil moisture at seeding time of the next crop. Seven years' data are available of the soil moisture content at seeding with the three fallow practices (table 1). Interestingly, reductions in soil moisture with delayed fallow during the first summer of fallow disappeared. Delayed fallow usually contained somewhat more soil moisture at seeding than did the two methods of early fallow.

There are two possible reasons why delayed fallow was equally efficient as early fallow in storing soil moisture.

TABLE 1
Available Soil Moisture at Seeding with Three Fallow Practices, Southwestern Great Plains Field Station, Bushland, Texas.

Year	One-way Tillage	Stubble-Mulch Tillage	
	Early fallow	Early fallow	Delayed fallow
	inches	inches	inches
1943	3.9	3.9	3.2
1944	6.1	5.5	6.1
1949	4.5	4.7	5.2
1950	3.3	5.3	6.4
1954	2.2	3.1	3.6
1955	3.4	3.2	4.0
1956	1.0	1.3	1.9
Average	3.5	3.9	4.3

First, standing stubble and intermixed weed growth of the delayed fallow area creates traps for blowing snow during the winter. Delayed fallow is usually much more effective in catching snow than either early stubble-mulch or one-way tillage (figure 1). Melting of the trapped snow supplies additional moisture on the delayed fallowed areas. Secondly, although the delayed fallow system may have less soil moisture after the first summer of fallow, there is a tendency for a dry soil to be more efficient in storing precipitation than a moist soil. As pointed out by Wiese and Army (11), summer and fall weed growth removes soil moisture, but this loss is compensated by an increased efficiency in the storage of rainfall the following spring.

Organic Matter and Total Nitrogen

Analyses were made at selected times to determine the effect of the three fallow practices on the organic matter status of the soil. When the experiment was initiated in 1941, the experimental area contained an average of 2.44 percent organic matter (table 2). After 15 years of experimentation, organic content of the soil had declined with all fallow treatments. However, organic matter content decline was greater with either of the early fallow practices than with delayed fallow. Organic matter content where stubble mulch early fallow had been used was somewhat greater than where one-way fallow had been employed. Additional analyses made in 1956 indicated that total nitrogen content was greatest

TABLE 2
The Effect of Three Fallow Practices on Organic Matter and Total Nitrogen, 0- to 6-Inch Depth, Southwestern Great Plains Field Station, Bushland, Texas.

Tillage	Fallow System	Organic Matter			Total Nitrogen
		1941[1]	1956	Change 1941 to 1956	1956
		percent	percent	percent	percent
Oneway	Early	2.44	1.74	−0.70	0.103
Stubble-mulch	Early	2.44	1.81	−0.63	0.108
Stubble-mulch	Delayed	2.44	1.93	−0.51	0.113
L.S.D.[2] 0.5 =		—	0.08	—	0.007

[1] The 1941 data are from Johnson, W. C. 1950. *Stubble-mulch farming on wheatlands of the Southern High Plains.* Circ. No. 860, U.S. Dept. of Agr., Washington, D.C.
[2] Least significant difference compared to oneway.

Figure 1. Delayed fallow, on the left, traps blowing snow that supplies valuable soil moisture. Note the lack of snow on the adjacent one-way disc fallow plot.

Figure 2. Delayed fallow immediately before the first tillage operation in the spring. With the standing stubble, weed and volunteer wheat growth, maximum wind erosion protection is achieved.

with delayed fallow. There was a tendency for the total nitrogen content to be higher with stubble-mulch than with one-way tillage.

Grain Yields

Wheat grain yields with the three fallow practices have been obtained for 14 years (table 3). Average yields of early and delayed stubble-mulch fallow were equal. Yields with one-way tillage early fallow were about two bushels less (statistically significant at the .01 level) than with the other fallow systems. Insect damage, which occurred in 4 years, was not related to fallow practices.

TABLE 3
Wheat Yields Under Three Fallow Practices, Southwestern Great Plains Field Station, Bushland, Texas.

Year	*One-way Tillage*	*Stubble-Mulch Tillage*	
	Early Fallow	*Early Fallow*	*Delayed Fallow*
	bu./ac.	*bu./ac.*	*bu./ac.*
1943[1]	11.9	14.6	12.9
1944	28.4	28.4	30.3
1945	16.7	20.4	23.3
1946[1]	8.5	13.9	15.4
1947	33.1	36.8	36.2
1948	13.9	15.7	15.6
1949	36.0	38.4	36.1
1950[1]	0.0	0.0	0.0
1951[1]	9.1	13.0	10.8
1952	16.0	17.4	16.8
1953	1.9	2.8	2.8
1954	14.3	18.4	19.8
1955	0.0	0.0	0.0
1956	0.0	0.0	0.0
Average (L.S.D.[2] 0.1=1.6)	13.6	15.7	15.7

[1] Insects damaged some or all of the plots.
[2] Least significant difference between means.

Erosion Control

In the southern Great Plains, no evaluation of tillage can be complete without considering the effects of wind erosion (9). Figure 2, a photograph taken in the spring when the hazard of wind erosion is greatest, reveals the added protection that delayed fallow affords. One-way fallow is least effective in controlling wind erosion. With the one-way, a portion of the crop residue is covered with each tillage and the soil is pulverized and void of a protective cover. Stubble-mulch tillage leaves a maximum amount of residue on the surface; but unfortunately, a portion of the residue is lost with each tillage operation. The residue is also left in a decumbent position that limits its effectiveness in reducing wind velocities near the surface. Delayed fallow gives a maximum of wind erosion protection during the critical late winter and spring blowing season in that the wheat stubble and first summer weed and volunteer wheat growth is left standing. With delayed fallow there is always a maximum amount of residue on the soil surface.

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Land Forming in the Southeast

PHELPS WALKER AND J. H. LILLARD

Research on land forming is quite limited in the southeastern part of the United States, though land forming is one phase of land preparation which is an accepted practice in many areas having surface drainage problems. Delays in soil preparation, planting, cultivation and harvesting due to water ponded in surface depressions make the use of poorly drained land marginal in most years. Efficiency in management and operation of machinery on this potentially productive land is extremely low until the appropriate drainage practices are established.

THE DATA and observations reported in this article are based largely on the information obtained to date from three large field experiments in Virginia. These studies were conducted to determine engineering design criteria and procedures for applying land forming to two soil and topographic conditions representative of those existing in the Southeast. The first two studies were on a fine-textured Coastal Plain soil having low infiltration capacity, poor internal water movement, and a topography characterized by frequent shallow depressions which varied in size from a few hundred square feet to several acres. Natural land slopes were between 0.05 and 0.15 percent. The third study was on a typical near-zero grade Piedmont Region river bottom where the topography is composed of series of ridges having well-drained medium-textured soils, and depressions having imperfectly and poorly drained fine-textured soils.

Review of Literature

Little information is found in engineering literature prior to 1950 on the application of land forming in humid regions. In that year, Saveson (6) reported that sugar cane yields and pounds of sugar produced on field tests in Louisiana increased with the degree of crown in land surface between drainage ditches up to a crown height of 13 inches. Increases in the amount of land covered by water in shallow ponds resulted in decreased yields. Later, he (7) reported that improved surface drainage resulted in an average increase of 5.81 standard tons per acre of sugar cane. Wood (8), in discussing land preparation for irrigation along the Missouri River, proposed designs to meet the requirements of both irrigation and surface drainage.

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Precise techniques for analyzing survey data to obtain balanced cutting and filling for rectangular boundaries were adopted from statistical procedures by Givan (4). Chugg (2) extended this method for application to irregularly shaped areas. Saveson (7) reviewed the machinery requirements for draining and forming Louisiana Delta soils. Much of this material is available in bulletins on land forming by Marr (5) and Gattis (3).

The rapidly growing interest in land forming in the eastern States is reflected in the literature. Borden (1) reported in 1955 that research on land-forming was under way in eight states and organized field projects established in eight additional states.

Procedures

Three land-forming methods were employed in this study (figure 1). In one method, the land surface was graded and smoothed to a predetermined slope in two directions. In the second method, the soil was moved to obtain a crowned (6-inch height for this test) cross-section profile and then smoothed in the direction of subsequent crop rows. The cross-section profile was not altered in the third method, where smoothing was performed only in the direction of future crop rows. In this procedure, referred to as the graded-row method, ridged or bedded rows were constructed to conduct runoff to disposal channels.

Land-forming procedures involve soil preparation, engineering surveys and analyses, primary forming with medium-size earth-moving equipment, and final smoothing with an automatically controlled land plane. Volumes of earth moved and time requirements for each of these operations were recorded for the inclined-plane and graded-row forming methods.

In the original Coastal Plain experiment a row-length study was superimposed on one 5-acre crowned plot and two 5-acre graded-row plots to determine the maximum practical length of each graded row when it handled its runoff. Test row lengths ranged from 100 to 600 feet and were replicated six times. Row channel grades were 0.10 and 0.15 percent. Supplemental observations of the second Coastal Plain experiment were made; these test

plots were formed to inclined planes having 900- and 1200-foot row lengths and 0.10 and 0.15 percent slopes. The first crop was grown on the 54-acre, 0.10 percent slope, Piedmont Region river bottom experiment in 1960, but information resulting from this experiment is not reported here. In that area a temporary shallow drain, located diagonally across the plot, permitted testing the drainage effectiveness of row lengths between 200 and 1150 feet.

Another phase of this experiment was the evaluation of subsurface drainage requirements for well-formed land. The test layout consisted of three inclined plane plots, one graded-row and one control plot which received no forming treatment. The control plot, the graded-row plot and one inclined-plane plot were each 200 feet wide, the accepted ditch spacing for many of the fine-textured soils in the Virginia Coastal Plain. The other two inclined-plane plots were 400 feet wide and were obtained by filling in lateral drainage ditches and combining two original 200-foot width tracts for each plot. A tile drain was placed in the center of one of the 400-foot plots to determine whether or not these wider formed plots would require supplemental subsurface drainage.

A study of the effect of soil manipulation and compaction during forming operations on subsequent crop yields was also a part of this experiment. Cut and filled areas were sampled separately and crop yields measured for each condition.

Results

Approximately 70 cubic yards of soil per acre were moved in the graded-row method of land forming and 220 cubic yards per acre for the inclined-plane method in the Coastal Plain. In both cases, the natural land slopes were adequate for formed slopes between 0.05 and 0.15 percent with maximum cuts of only 0.7 foot. Plot sizes ranged from 6 to 13 acres. Subsequent observations and data seemed to favor the higher 0.15 percent grade as being the most satisfactory for the Coastal Plain soils with poor internal drainage. Thus, it was decided that a 0.10 percent slope would be adequate for better drained Piedmont river bottom lands occurring on near-zero grade and in tracts larger than generally found in the Coastal Plain. Both of these conditions, field size and topography, affect land-forming costs. Forming a 54-acre field in a near-zero grade Piedmont river bottom, where it was necessary to cut for a minimum formed grade of 0.10 percent, required moving 635 cubic yards per acre and cuts up to 2.5 feet. The ratio of volume of soil cut to that of fill was about 1.5 to 1 for all plots.

In the earlier Coastal Plain experiment, winter settling of the filled areas necessitated additional forming. To overcome this problem, a 10-percent overfill was made in the Piedmont river bottom to offset the anticipated settling. If this estimated overfill value proves adequate and advisable, the per acre volume of earth moved would be larger than that given for the Coastal Plain conditions.

Time requirements for primary forming operations were in direct proportion to the volumes of earth excavated. Only 0.7 hour per acre was needed for moving earth in the graded-row method. Complete forming to an inclined plane representing the natural land slope in the Coastal Plain averaged about 2.1 hours per acre; but the Piedmont river bottom experiment, where deep cutting was necessary, required 6.8 hours per acre. Final smoothing operations with the land plane consumed between 2.1 and 2.6 hours per acre for all plots.

Technical supervision and labor used for staking, surveying, analyses of surveys, and supervision of forming procedures averaged about six man hours per acre.

The forming costs, excluding surveys, analyses and supervision, are summarized in table 1.

Crop yields from three corn crops and three soybean crops grown on the original row-length study in the

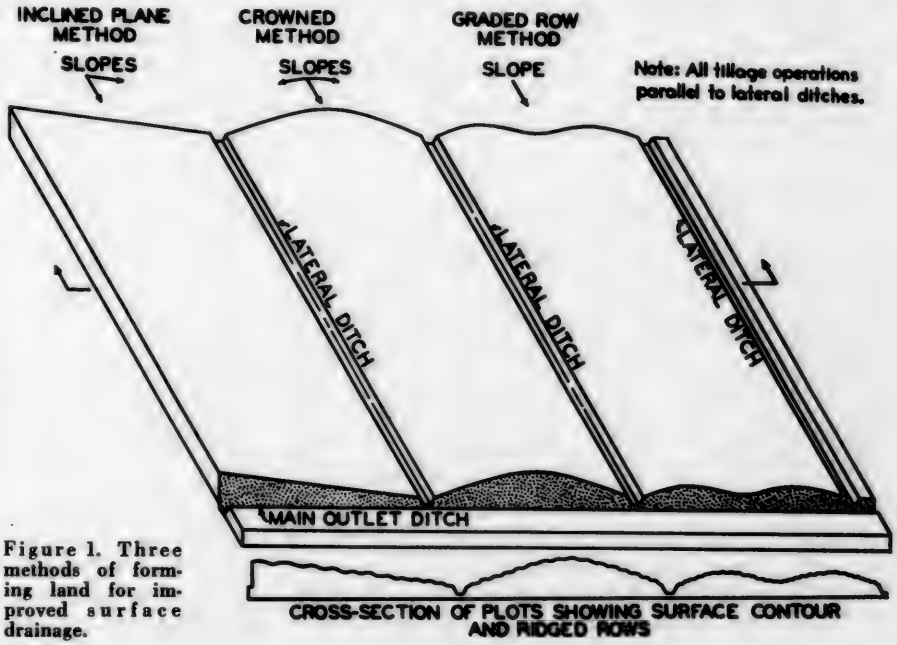


Figure 1. Three methods of forming land for improved surface drainage.

Figure 2. Primary land forming operations involving the moving of large volumes of soil require the use of pan-type scrapers. Depth of cut is shown by the grade stake on the soil mound in the forground.

Figure 3. Planing the soil to smooth grade is performed with an automatic land plane. This is the last land-forming operation before preparing the seedbed for a crop.

TABLE 1

Land Forming Yardages and Costs per Acre at Two Locations in Virginia.

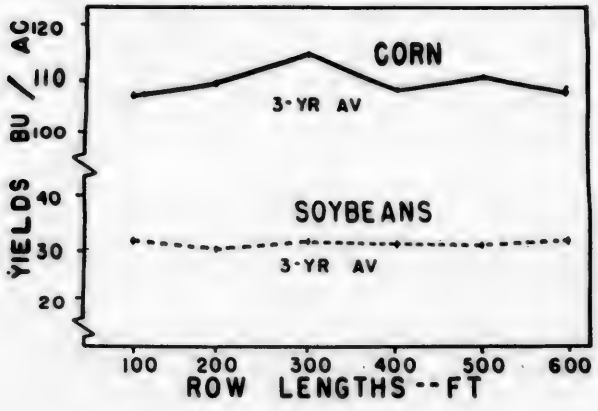
Location and Forming Method	*Total Volume of Cuts*	*Total Land Forming Costs*
	cu. yds./acre	*dollars/acre*
Coastal Plain		
One direction grading (graded row)	70	35
Two direction grading (inclined plane) using natural land slopes...	220	65
Piedmont		
Two direction grading (inclined plane) and cutting for minimum formed slopes	635	115

Coastal Plain are summarized in figure 4. Although minor variations in crop yields did show up immediately after forming, significant differences in yields for both corn and soybeans disappeared the third year. The data also indicated that there is no benefit from crowning in addition to smoothing to obtain continuous row grades.

Differences in first year corn from the 200- and 400-foot width plots were not significant. This may mean that surface smoothing lowers the internal soil drainage requirements and thereby permits much larger distances between drainage ditches.

The manipulation of soil by forming operations resulted in a first year corn yield reduction from 122 bushels per acre to 114 bushels per acre on the formed plots (significant at the 1 percent level). Excess surface water on the area not formed was disposed of through random-located, hand-cut shallow drains. The data show that yields on the filled areas were 9 percent higher than on the cuts. Likewise, average yields from the shallower cuts and fills were 10 percent higher than those from the deeper cut and fill areas (significant at the 1 percent level).

Figure 4. Grain yields as related to row length in a study at Baum Farm, St. Brides, Virginia, 1954-1959.



Discussion

Results from tests in Virginia indicate the practicability of the graded-row method of land forming for fine-textured Coastal Plain soils where ridged-row tillage is practiced and a continuous row grade of at least 0.15 percent is maintained. The inclined-plane forming method is more expensive than the graded-row method, but it may be a more suitable solution to the surface drainage problems where prevailing slopes are very low and where ridged-row tillage may or may not be used. Grading land to a crowned surface is an expensive and inefficient method of solving surface drainage problems in areas of general farming.

The forming costs and volumes of earth moved per acre in these experiments were probably higher than would be encountered in general application of the practice because extreme conditions were selected for the studies. Necessary engineering surveys and computations and the additional tillage operations frequently required to overcome soil compaction and other soil physical problems will increase the initial cost figures by 10 to 25 percent. Periodic maintenance smoothing is always required, but this usually replaces a tillage operation and adds little to the cost of crop production.

Total costs for forming land compare favorably with other drainage methods practiced in the region.

The mixing of soil plus the compaction caused by machinery traffic gave an initial depressing effect on crop yields. This effect was soon overcome in the earlier studies through good management and subsequent tillage. This problem is under continued study in a more detailed field experiment.

Land forming contributes to more efficient farming operations by permitting the full utilization of potentially productive wet lands. In many cases, land formed to facilitate drainage is suitable for the application of surface irrigation. The use of land forming for both drainage and irrigation is expected to grow steadily over the next few years.

Much of the rolling land in the Southeast has been either terraced or contour stripped. Many crops are planted in row layouts designed for continuous row drainage. The application of these soil conservation practices to the unaltered natural land surface results in row patterns and arrangements which greatly reduce the efficiency and sometimes prevent the use of modern agricultural implements. There is a great need to use modified forming methods for terrace and contour strip simplification and land smoothing to facilitate crop row layout for improved drainage.

Summary

In summarizing the current information on land forming in the Southeast, it seems reasonable to conclude that:

1 The practice of land forming will become increasingly important as more knowledge and experience in its application to specific conditions become available.

2 The studies in Virginia on two widely different soil and topographic conditions indicate that on soils with poor internal drainage it is desirable to form slopes of about 0.15 percent while on the better drained soils, it is probable that a 0.10 percent slope will provide adequate surface drainage.

3 Under many soil conditions where ridged-row cultivation is to be practiced, forming to a continuous grade only in the direction of crop rows will provide satisfactory surface drainage at minimum forming costs. On the other hand, where the natural land slopes are very low (less than 0.10 percent), therefore requiring precision in the forming operations, it may be preferable to completely form the land in both directions.

4 Forming costs will range from a low of about $35 per acre for the one direction forming with ridged-row cultivation to $65 per acre where complete forming in both directions is performed without cutting for grade above the natural land slope. On near-zero slopes where extensive cutting to obtain the desired grade is necessary, this cost may be doubled. Also, the cost is affected not only by the topographic features of the land but also by the size and shape of the area.

5 Soil mixing and compaction resulting from forming operations often have initial adverse effects upon crop yields and additional operations are required to overcome them. In all cases, it is desirable to practice periodic smoothing to maintain formed grades.

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Use of Soil Moisture by Cotton

JOHN F. THORNTON

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FOR A LONG TIME cotton was considered a dry-weather plant by farmers in the South. Yet, cotton yields have been reduced in many areas nearly every year because of lack of moisture at critical times, and as a consequence, the income of farmers in the drouth areas was adversely affected. The economic risk to cotton growers is becoming increasingly serious because of mounting fixed overhead costs of farm operation, the higher rates of fertilizer input and the narrower margins between farm expenses and income.

Recent irrigation studies throughout the South show that since cotton yields are limited by the amount of available moisture at certain periods during the growing season (2), cotton should not be "stressed," i.e, undergo drought conditions, if optimum yields are to be obtained.

Sir E. John Russell of the Rothamstead Experiment Station in England explained the role of water in plant

growth as follows: "Water is an essential nutrient for plant growth, and it is needed in much larger quantities than any other; but whereas a large proportion of every other nutrient absorbed by the plant is retained, the outstanding characteristic of the water is its continuous one-way flow from the soil through the roots, up the stems and into the leaf surface, where it is evaporated mainly inside the stomata, through which it diffuses into the air" (5). Russell also pointed out that the amount of water a crop transpires depends upon the amount of water available to the plants, the period of day in which the stomata of the leaves are open, and the solar energy falling on the crop.

Of the solar energy falling on a wet surface, part is reflected, part is re-radiated, part is used to heat up the absorbing material and the air around it; and the remainder evaporates water from the surface. Of the solar energy falling on plant leaves, the part used for photosynthesis is negligible since it is less than 1 percent of the total.

Bloodworth et al. (1) showed that water movement through the stem of a cotton plant is proportional to the availability of the soil moisture.

Experimental Procedures

Experiments have been underway at the Southern Piedmont Experiment Station at Watkinsville, Georgia, since 1952 to determine the rate and amount of moisture used by cotton. The studies were on an upland field of of Cecil sandy loam soil, and the cotton variety grown was Coker's 100 Wilt Resistant. Fertilizer was applied at the rate of 500 pounds per acre of 0-12-12 broadcast before planting, 500 pounds per acre of 4-12-12 in the row at planting, and nitrogen side dressing about 40 days after planting. Comparisons of nitrogen levels made in 1954 and 1955 showed no difference in yield between 60 pounds per acre of N and 120 pounds per acre of N. In 1956, 120 pounds per acre of nitrogen was applied.

Moisture level treatment varied from irrigation versus no irrigation during 1952 to 1954, to a comparison of several levels of soil moisture in 1956.

Results

The rate of moisture use for the different levels of soil moisture by years is given in table 1. These data show considerable difference in the peak rate and the average daily rate of water use each year. There were variations from one year to the next in both the peak and average rates of moisture used and between different moisture levels within the same year.

The peak rates were determined over short periods of only a few days duration. It is believed the average rate of 0.20 inch per day during the main growing season represents the moisture use requirement of cotton under the conditions of this experiment.

The amount of water used (transpiration and evaporation) from stored soil moisture, rainfall and irrigation are shown in table 2 for the different treatments in 1955 and 1956. Rainfall during the growing season was 6.99 inches in 1955 and 8.10 inches in 1956. In 1955, without irrigation, the cotton used 4.34 inches of moisture from the soil and a total of 11.33 inches of water. Without irrigation in 1956, the cotton used 3.05 inches of moisture from the soil and a total of 11.5 inches of water. The amount of stored water used from the soil was lessened markedly in 1955 where additional water was applied. However, irrigation treatments had little effect on the amount of water used from the soil in 1956.

The data indicate that 70 percent of the water was used from the top 1 foot of soil and 90 percent came from the top 2 feet. It was only toward the end of August that water was used extensively from the third foot of soil, regardless of the level of soil moisture. About half the available moisture was left in the 3 to 4-foot layer at the end of the growing season, indicating that plant roots were not using as much water from that layer of soil.

These data are at some variance from other data on the use of moisture by cotton on the deeper soils of the southwestern states. The pattern of use in that area was reported by Krantz et al. (4) to be:

TABLE 1

Average Daily Rate of Moisture Use by Cotton Under Various Levels of Available Water During the Growing Season of June, July and August at Watkinsville, Georgia, 1952-1956.

Year	Moisture Level at Irrigation in Top 2 Feet of Soil	Rate of Evapo-transpiration for Cotton			
		Irrigated		Not Irrigated	
		Maximum inches/day	Average inches/day	Maximum inches/day	Average inches/day
1952	10 percent AWC[1]	0.31	0.196		0.113
1953	10 percent AWC	0.34	0.213		No record
1954	30 percent AWC	0.31	0.216		0.184
1955	60 percent AWC	0.22	0.175	0.25	0.130
1955	30 percent AWC	0.30	0.180		....
1956	60 percent AWC	0.36	0.256		....
1956	30 percent AWC	0.32	0.218		....
1956	Observed wilt	0.27	0.177		....
1956	Observed wilt plus 5 days	0.26	0.173		....
1956	0 percent AWC	0.25	0.181		....
1956	Not irrigated	...	....	0.27	0.124
Average			0.199		0.146

[1]Available Water Capacity

Soil Depth	*Water Used*	
feet	*inches*	*percent*
0-1	13.5	38.2
1-2	8.3	23.5
2-3	5.5	15.6
3-4	4.1	11.6
4-5	2.5	6.5
5-6	1.6	4.5
Total	35.5	99.9

The total of 35.5 inches of water used corresponds closely with data reported by Harris and Hawkins (3) where cotton near Mesa, Arizona, used a total of 36.4 inches of water during the entire season and water use by months was 1.0, 2.1, 4.0, 7.5, 8.3, 6.1 and 3.4 inches for April to October, inclusive.

The data in table 2 covers only the 90-day period from May 28 to August 25. Evapo-transpiration during the periods extending from planting (about April 15) to the first of June, and from August 26 until harvest was completed (about October 15) would require an additional estimated 6 or 8 inches of water. Assuming 7 inches of moisture were required for these two periods and using the data from table 2, the range of moisture requirements for cotton from planting to harvest at Watkinsville, Georgia, would be 18-30 inches.

The yields of cotton from the different levels of soil moisture in 1955 and 1956 are given in table 3. Insect control and other production factors were managed for maximum production in these studies.

Cotton yield increased in proportion to available moisture up to a level of about 18 inches during the 3-month growing season. With more than 18 inches of moisture there was a slight increase in yield.

The three low levels of irrigation did not affect the maturity date of cotton. The main effect of the two irrigations applied in these treatments was to develop bolls already set rather than to set new ones.

Vegetative growth was proportional to moisture use. The height of plants measured 18 to 24, 36 to 42 and above 60 inches respectively for the limited, optimum, and excessive quantities of water used.

TABLE 2

Source and Amount of Water Used by Cotton in 1955 and 1956 in Studies at Watkinsville, Georgia.

Moisture Level at Irrigation	Soil moisture		Rainfall		Irrigation		Total	
	1955 inches	1956 inches	1955 inches	1956 inches	1955 inches	1956 inches	1955 inches	1956 inches
None	4.34	3.05	6.99	8.10	0	0	11.33	11.15
0 percent AWC[1]	—	2.46	—	8.10	—	5.76	—	16.32
Observed wilt plus 5 days	—	3.19	—	8.10	—	4.32	—	15.61
Observed wilt	—	3.47	—	8.10	—	4.32	—	15.89
30 percent AWC	2.24	2.86	6.99	8.10	6.48	8.64	15.71	19.60
60 percent AWC	2.46	3.74	6.99	8.10	5.76	11.16	15.21	23.00

[1]Available Water Capacity

TABLE 3

Yield of Seed Cotton and Amount of Soil Moisture Used in Studies at Watkinsville, Georgia, 1955-1956.

Year	Moisture Level at Irrigation	Water Used inches	Yield pounds per acre	Yield pounds per acre per 1" of water	Yield with irrigation pounds per acre	Increase pounds per acre per 1" of irrigation
1955	None	11.33	2383	210	—	—
1955	30 percent AWC[1]	15.71	3104	198	821	127
1955	60 percent AWC	15.21	2880	189	497	86
1956	None	11.15	1952	175	—	—
1956	0 percent AWC	16.32	3621	222	1670	290
1956	Observed wilt plus 5 days	15.61	3306	212	1354	313
1956	Observed wilt	15.89	2911	183	958	222
1956	30 percent AWC	19.60	3463	177	1510	175
1956	60 percent AWC	23.00	3257	142	1305	117

[1]Available Water Capacity

Conclusions

1 Cotton should have an ample but not excessive supply of moisture throughout the growing season.

2 Yields of cotton are proportional to available moisture up to about 6 inches per month during June, July and August.

Cotton on soil with lower-moisture treatments showed a more efficient use of available moisture than did cotton on soil receiving moisture treatments. As soil moisture increased, the efficiency of water use for cotton production decreased.

Cotton needs a good supply of moisture during the boll setting period and until three-fourths of the bolls are mature. Normally two good irrigations are sufficient to insure good yields. Moderate drought in the early growing period does little harm if cotton gets moisture for the development of bolls already set. Water applied at the time of wilting will increase the yield of cotton 86 percent over yields obtained without irrigation. At 1956 prices this yield increase was worth $217.10 per acre.

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New Tillage Methods Reduce Erosion and Runoff

ORVILLE E. HAYS

An excessively cultivated soil holds less rainfall in surface storage, crusts over more easily during intense rainfall, and has higher runoff and soil loss than the same soil under a minimum tillage management program. Studies conducted on Fayette silt loam at the Soil and Water Conservation Experiment Station near LaCrosse, Wisconsin, have been designed to determine the effects of special soil management practices on soil and water losses. These studies involved seedbeds for corn and small grain and interseeding legumes in corn.

STRIP CROPPING AND TERRACING are recognized as essential practices for cropping sloping land in the Upper Mississippi Valley. The amount of soil and water movement within a strip or between terraces is influenced in large measure by the soil management practices used on the area as well as by the soil type and percent slope.

The period of study covered in this article includes the years 1954 through 1959. Soil losses from land in corn and grain were below normal during 3 years, about normal 1 year and above normal during 2 years. Soil losses for the 6 year period averaged less than for the 26 year period during which measurements have been taken. Data obtained in 1959 when soil losses were considerably above normal, give confidence in the ability of the treatments to reduce soil and water losses during intense rainfall.

Seedbeds for Corn

In 1955, an experiment was started to determine the influence of type of seedbed on runoff and erosion from land in corn after having been in hay. The plots, located on a 15 percent slope, were 20 feet wide and 100 feet long. The seedbed treatments, replicated three times, included: (1) Normal seedbed—following a crop of hay, the soil was plowed in the spring and worked several times with a disc and field cultivator to a surface condition typical of the conventional farm seedbed. (2) Wheel-track plant—following a crop of hay, the soil was plowed in the spring and the corn planted in the tractor wheel tracks without other seedbed tillage. (3) Mulch—the sod was cultivated in the fall and spring with a field cultivator.

The corn was cultivated as needed. The wheel-track planted corn usually required two cultivations and the normal and mulch treatments required three cultivations to accomplish about the same degree of weed control.

Beginning with fall tillage of the mulch treatment and continuing through the corn year, soil and water losses from each rain causing runoff were measured.

TABLE 1
Average Annual Soil and Water Losses and Yields on Fayette Silt Loam, 15 Percent Slope, 1955-1959.

Type of Seedbed	*Runoff*	*Soil Loss*	*Corn Yield*	*Population*
	inches	*tons per acre*	*bushels per acre*	*plants per acre*
Normal	0.81	2.94	97.4	14,590
Wheel-track	0.35	0.70	86.8	13,489
Mulch	0.42	0.75	94.8	13,236

Runoff and soil loss from the wheel-track and the mulch seedbeds were similar. These treatments reduced runoff about 50 percent and soil loss about 75 percent as compared to the normal treatment. Corn yields were slightly higher on the normal seedbed than on the wheel-track and mulch seedbeds. The yield was influenced by the lower plant population in the wheel-track and mulch treatments. The depth of planting varied more on these treatments than on the normal seedbed. To obtain good stands with wheel-track planting requires a smooth job of plowing.

Corn Stover Mulch

The effect of corn stover mulch on soil and water losses from land in corn after corn has been under measurement at LaCrosse since 1954 on a 16 percent slope Fayette silt loam, and at Madison (Wisconsin) since 1955 on a 9 percent slope Miami silt loam. The LaCrosse plots were 6 feet wide by 72.6 feet long. The Madison plots were 20 feet wide by 200 feet in length.

This article by Orville E. Hays is a slightly revised version of a paper presented by him at the Fifteenth Annual Meeting of the Soil Conservation Society of America, Guelph, Ontario, Canada.

Mr. Hays is superintendent of the Soil and Water Conservation Experiment Station, LaCrosse, Wisconsin. Cooperating in the studies reported in this article were the Soil and Water Research Division, Agricultural Research Service, U.S. Department of Agriculture and the College of Agriculture, University of Wisconsin. The Allis Chalmers Manufacturing Company cooperated in the design and construction of implements.

In both experiments the corn stover produced on the plots was chopped and distributed over the surface as a mulch. Fifteen pounds of nitrogen were applied with each ton of chopped stover. At LaCrosse the seedbed was prepared with a small rototiller without plowing. At Madison the seedbed was prepared with a field cultivator without plowing. The corn was cultivated so as to leave as much mulch on or near the surface as possible. Table 2 shows soil and water losses and corn yields on a corn stover mulched seedbed compared with soil and water losses and corn yields of corn in a corn, small grain, hay rotation. In the rotation plan the hay land was plowed for corn and a conventional seedbed prepared.

TABLE 2

Soil and Water Losses and Yields of Corn from Land in Corn After Corn with Corn Stover Mulch and from Land in Corn in a Corn-Grain-Hay Rotation.

Treatment	*Runoff*	*Soil Loss*	*Corn Yield*
	inches	*tons per acre*	*bushels per acre*
Fayette Silt Loam, LaCrosse			
Average—1954-1959			
Corn in C-G-H- rotation	0.60	2.00	120.0
Corn after corn and corn stover mulch	0.11	0.16	125.6
Miami Silt Loam, Madison			
Average—1955-1959			
Corn in C-G-H rotation	0.79	1.42	78.6
Corn after corn and corn stover mulch	0.06	0.01	76.1

In both studies soil and water losses were much less from land in corn after corn with the corn stover mulch treatment than from land in corn in a corn, small grain, hay rotation. Corn yields in the corn after corn system with corn stover mulch were about the same as from corn after one year of hay.

Seedbeds for Small Grain

In 1957, a study was started on Fayette silt loam to determine the influence of type of seedbed on soil and water losses from land in small grain following corn. The plots, on a 15 percent slope, were 20 feet wide and 100 feet long. The seedbed treatments, replicated three times, included: (1) Fall plowed—seedbed prepared with disc and field cultivator; (2) field cultivated—seedbed prepared by use of field cultivator in the fall and spring; and (3) corn stover mulched—chopped corn stover was applied to the soil surface in the fall and the field cultivator used in the fall and spring to prepare the seedbed. Oats were seeded and fertilized uniformly across all plots on the contour.

TABLE 3

Average Annual Soil and Water Losses and Yields from Land in Small Grain on Fayette Silt Loam, 15 Percent Slope, 1957-1959

Type of Seedbed	*Runoff*	*Soil Loss*	*Yield*
	inches	*tons per acre*	*bushels per acre*
Fall plowed	3.56	11.77	91.2
Field cultivated	2.83	6.78	83.5
Corn stover mulched plus field cultivated	1.90	2.23	88.4

Preparing the seedbed with the field cultivator reduced runoff by about 20 percent and soil loss by about 50 percent. The addition of corn stover as a mulch reduced runoff by about 45 percent and soil loss by about 80 percent as compared with the normal seedbed (table 3).

High soil losses most frequently occur during the period from seedbed preparation to about a month after planting. It is during this period that minimum tillage and mulches are needed to protect the soil until the crop is well established and offering protection. Tillage in seedbed preparation is necessary only to loosen the soil, to kill existing vegetation and to prepare a suitable soil bed into which the seed can be planted. Excessive tillage will increase the cost of producing the crop and will usually result in higher runoff and soil losses. The amount of tillage required will vary with the crop and the soil.

Interseeding Legumes in Corn

High soil and water losses and the lodging of grain planted in the spring have increased interest in establishing legumes in corn. Measurements at LaCrosse show that

Grain drill modified for interseeding. The center gang is removed to allow passage for the corn row and it is equipped with packing wheels to firm the soil over legume and grass seed.

Alfalfa interseeded in corn with the modified grain drill when the corn was 20 inches high.

The two crop system—removing hay, plowing and wheel-track planting of wide-row corn—reduces erosion and runoff.

land plowed for small grain, following corn in a 3 year rotation with meadow, lost two and one-third times as much runoff and four times as much soil as land plowed for the corn during the period 1954 to 1959.

Satisfactory stands of legumes can be established in wide row corn; these stands will produce hay yields which compare favorably with yields of hay seeded in small grain. Early studies at this station showed that good stands of legumes could not be established in conventional 40-inch corn rows. An experiment with wide corn rows was established in 1954 on plots 10 feet wide and 72 feet long located on a 16 percent slope. In this study the treatments, replicated twice, included: (1) Corn, grain, hay—corn in 40-inch row spacing (no interseeding); (2) corn, hay, hay—interseeded in corn in 60 inch row spacing; and (3) corn, hay, hay—interseeded in corn in alternate 40-80 inch row spacing.

The soil was spring plowed at corn planting time. The plowed soil was disced once during seedbed preparation and planted in the conventional manner. Soon after the second cultivation, when the corn was approximately 20 inches tall, the 60 and alternate 40-80-inch rows were interseeded. During the first 2 years of the study a small cultipacker interseeder was used. After that time a grain drill was modified for interseeding by removal of one drill assembly and by the installation of packing wheels. The drill was found to be more satisfactory for sloping land as the corn row was straddled and seed was also broadcast in the corn row. The alfalfa was band seeded at 10 pounds per acre and the bromegrass broadcast at 3 pounds per acre. At the time of interseeding, 0-20-20 fertilizer was applied at the rate of 400 pounds per acre.

During the 6 year period, land in corn interseeded in 60-inch rows lost about the same amount of runoff and about one-half as much soil as the land in unseeded 40-inch rows (table 4). Rains soon after interseeding

TABLE 4

Average Annual Soil and Water Losses from Land in Corn Interseeded with Alfalfa-Brome and from Land in Corn Not Interseeded, 1954-1959.

Treatment	*Runoff*	*Soil Loss*
	inches	*tons per acre*
40 inch rows not interseeded	1.07	5.80
60 inch rows interseeded	1.06	3.04
40-80 inch rows interseeded	1.27	5.46

resulted in higher soil and water losses from the interseeded area due to the smoothing and packing of the soil by the seeder. As the seeding became established, soil and water losses were less from the land in interseeded corn. Soil and water losses were higher from the land in alternate 40-80-inch row interseedings than from the 60-inch rows. This is probably due to the fact that prior to the establishment of the interseeding more of the soil is exposed to the rainfall in the 80-inch rows than in the 60-inch rows.

Soil and water losses were measured under all crops so as to obtain losses by rotations. For the 6 year period the corn, grain, hay rotation lost 1.19 inches of runoff and 4.00 tons of soil per acre. The land in corn, hay, hay rotation interseeded in 60-inch corn rows lost 0.86 inches of runoff and 1.05 tons of soil per acre.

Corn yields were reduced by wide row planting. Planting corn in alternate rows reduced yield by 18 percent, and planting in alternate 40-80-inch rows reduced corn yield by 22 percent when compared with 40-inch noninterseeded rows. The corn plant population per acre was higher in the 40-inch rows. There are more plants per lineal foot of row in the wide spaced rows; these closer spaced plants appeared to be affected more by dry weather than the corn in the 40-inch rows.

In order to determine the best time to interseed, and the effect of interseeding on corn yields, seedings were made at corn heights of 3, 10, 20, and 30 inches in comparison with plots that were not interseeded. All plots were cultivated as needed until interseeded or until the corn was too tall to cultivate. The results of this experiment are given in table 5.

TABLE 5

Height of Corn at Time of Interseeding as Related to Corn Yields, 1956-1958.

Corn Height at Interseeding	*3-Year Average Corn Yield*
inches	*bushels per acre*
3	68.4
10	86.2
20	84.0
30	86.3
Not interseeded	88.8

Interseeding at the 3-inch height reduced corn yields by about 20 bushels per acre. This reduction in yield was due largely to more weeds and to more competition from the legumes than when interseeding was done later.

Interseeding at 10, 20, and 30-inch heights had very little influence on corn yields.

Better stands of legumes are established during years of normal and below normal rainfall than during years with above normal rainfall. Table 6 shows the average stand counts of alfalfa established from interseeding at various corn heights in 1956, 1957, and 1958. Rainfall during the period of April through September was 16.36 inches in 1956, 25.44 inches in 1957, and 13.56 inches in 1958. The rainfall and soil moisture were below normal in 1956 and 1958 and above normal in 1957. The number of plants per square foot was nearly twice as high in 1956 and 1958 as in 1957. In wet years the corn grows more rank and weeds will frequently reduce survival of legumes.

TABLE 6
Stand Counts of Alfalfa Plants per Square Foot When Interseeded in Corn at Various Heights.

Year	*Corn Height at Time of Interseeding*			
	3 inches	*10 inches*	*20 inches*	*30 inches*
	Number of Alfalfa Plants per Square Foot			
1956	14.3	12.9	17.2	18.9
1957	6.0	10.5	11.5	6.7
1958	18.0	23.1	14.5	17.9
Average	12.8	15.5	14.4	14.5

Yield of hay the first year after interseeding was about 0.3 ton less than hay seeded in small grain. However, the second-year hay from interseeding averaged about 0.2 of a ton per acre more than hay seeded in small grain. Therefore, hay yields from seeding in corn and seeding in small grain are quite comparable.

Conclusions

Minimum tillage and the use of mulches will greatly reduce soil and water losses from cultivated strips and the intervals between terraces. On corn after hay, wheel track planting and preparing the seedbed with a field cultivator each reduced runoff by about 50 percent and soil loss by about 75 percent. Corn stover mulch in corn after corn gave excellent control of runoff and erosion at LaCrosse on a 16 percent slope and at Madison on a 9 percent slope. For a 6-year period at LaCrosse, runoff averaged 0.11 inch and soil loss 0.16 tons per acre and at Madison for a 5-year period runoff averaged 0.06 inch and soil loss 0.01 ton per acre.

Soil losses from land in small grain can be reduced about 50 percent by use of a field cultivator for seedbed preparation in place of plowing. Chopping the corn stover as a mulch on the soil surface and preparing the seedbed with a field cultivator will reduce soil losses by about 80 percent as compared to seedbed preparation by plowing.

Interseeding legumes in wide row corn will successfully establish stands of hay which produce yields comparable to seedings made in small grain. The rotation, corn-hay-hay, will allow about one-fourth as much soil loss as a corn-small grain-hay rotation, largely because the small grain crop with its high soil loss is replaced by a year of hay with low soil loss.

An Introduction to the Scientific Study of the Soil. *By the late* NORMAN M. COMBER. *Fourth edition revised by* W. N. TOWNSEND. *232 pp., illus., index, 1960. Edward Arnold, Ltd., London; available from St. Martin's Press, 175 Fifth Avenue, New York, N. Y. $4.75. (Reviewed by* W. J. HANNA, *New Brunswick, New Jersey.)*

This little volume is a long over-due revision of Professor Comber's lecture material for his introductory course in soils. The last revision was made in 1936 by Comber.

The book has been extensively revised and rearranged, mostly for the better. The subject matter on clay minerals, chemistry and classification has been brought up to date.

Mr. Townsend has regrouped the chapters and subject matter into two major subdivisions, pedological and edaphological. The number of chapters has been increased from fifteen to nineteen, and twenty-six pages were added. He has treated the areas of genesis and classification very ably except that the role of organisms in soil development is not given sufficient emphasis.

The chapter, "Soil Fertility," which serves as the introduction to the second part of the book on edaphology, would be better entitled "Soil Productivity," since other management factors than maintenance of fertility are discussed. Soil conservationists will be particularly interested in the chapter on "Soil Deterioration."

This is a book for the beginner in soils. It is written in a style easily read and can be understood by the person with limited technical background.

Economics in Watershed Planning. *Editors:* G. S. TOLLEY *and* F. E. RIGGS. *336 pp., index, 1961. The Iowa State University Press, Ames, Iowa. $3.95. (Reviewed by* ALVIN C. WATSON, *Upper Darby, Pennsylvania.)*

This comprehensive book involves the past, the present, and the future of watershed studies, planning, and development. It contains philosophies, objectives, analyses, and procedures—with suggestions. The book, as a whole, is especially useful to students of the watershed approach to resources conservation and planning.

The 20 chapters of this book contain a symposium which was sponsored in 1959 by the Southeast Land Tenure Research Committee, the Farm Foundation, and the Tennessee Valley Authority. It contains the works of 20 authors, with comments by 33 others. These authors range from various kinds of scientists and researchers to administrators and staff assistants, as well as those in the legal profession. While the book is titled *Economics of Watershed Planning*, it deals with many other aspects of this field. Parts of it are difficult reading, while others are extremely interesting and challenging.

It is repeatedly pointed out that watershed planning and operations as conceived under Public Law 566 was intended to and actually is filling an important gap in the water resources planning of the Nation. One gets the impression that the watershed work being done under this Act is outstandingly good but there are numerous opportunities for refinements and improvements.

Excellent statements are made concerning the importance of soil conservation districts in watershed planning and operation, and it contains many suggestions concerning optimum watershed development. Many of the authors point out the future opportunities for multiple-purpose developments and benefits which will accrue to urban interests. The book is recommended reading.

Modern Land Policy. *449 pp., index, the 32 papers of the Land Economics Institute, 1960. University of Illinois Press, Urbana, Illinois. $8.50. (Reviewed by* A. ALLAN SCHMID, *East Lansing, Michigan.)*

Large shifts between major land uses are unlikely in the future, but the localized intensification of uses which occur will create more social stress and strain. This is the conclusion of Marion Clawson in the opening chapter in this book of essays on land problems and policies.

Among the chapters in Part I on potentials in land resources and demand George Tolley outlines the effect on demand for land of changes in population, income, efficiency in livestock production, and labor costs. C. P. Barnes predicts that with the aid of science the outlook for land resources to keep up with population growth looks good for the next 200 years. Andrew Aandahl presents data on selected soils showing that yields could be 50 to 100 percent higher in 1980 than at present if available knowledge is fully used.

The thought provoking idea that the relative supply price of land as a productive input has been declining is presented by Theodore Schultz. His hypothesis is that the key to increases in economic growth is found in investments in human capital such as education rather than in land, labor, or physical capital. This reviewer would like to add, however, that although other inputs have been substituted for land to increase production this substitution has limits. More research is needed on the returns on investments in the improvement of land quality as compared with other public and private investments for agricultural production.

Essays on the effect on land use of specific demands for urban growth, highways, recreation, timber, and water are contained in Part II. Louis Wetmore emphasizes the need for continuous planning on a regional base oriented around urban centers and natural resource complexes. Paul Johnson throws out the new policy suggestion of a federal land reserve board which could develop methods of increasing and decreasing the land in agricultural production much like the Federal Reserve System regulates money and credit supply.

Planning and programming land resources policy is the third part of this book. Charles Hardin argues that the development of a strong but accountable national coordinated planning is necessary in agriculture for national survival in the modern world. Hardin acknowledges the inherent dangers of totalitarianism in this type of planning but urges that the task cannot be avoided.

Philip Raup predicts that we will be increasingly occupied with urban interests in rural lands and that the fertility aspects of land will not be as strategic as space aspects. However, he points out that urban land uses are not necessarily the "highest and best." We should not treat urbanism itself as a goal and be guilty of "urban fundamentalism" as we have sometimes been guilty of rural fundamentalism in the past. Other essays discuss such things as the role of the family farm, land classification as a tool in problem solving, and the role of law in land development.

The concluding group of chapters is on land use and tenure problems in the United States and foreign countries. Only a few of the essays from this valuable survey book could be highlighted here.

People! Challenge to Survival. *By* WILLIAM VOGT. *257 pp., index, 1960. William Sloane Associates, 425 Park Avenue South, New York 16, N. Y. $4.50. (Reviewed by* WALLACE E. AKIN, *Des Moines, Iowa.)*

This book deals with the problem of over population and makes a very strong case for population control.

Considering the subject matter and the tendency of laymen and "experts" alike to take extreme stands on this question, it promises to be even more controversial than his *Road to Survival*.

Written in Vogt's readable, fast-moving journalistic style, *People* is based on a background of travel in more than 25 countries and most of the United States. It is a record of his observations, impressions, and conclusions about over population, and a consideration of those measures which he believes might lead to solutions. As usual, the author pulls no punches, criticizes where he believes criticism is due, and does not hesitate to make controversial and, to some, shocking recommendations. As indicated by the author, this is a presentation of only one side of the population question.

Whether the reader will agree with all the author has to say, or only part of it, or disagree completely with his interpretation of the population problem, the book cannot fail to be stimulating reading.

Loblolly Pine. *By* W. G. WAHLENBERG. *603 pp., bibl., appendix, index, 1960. The School of Forestry, Duke University, Durham, North Carolina, in cooperation with the Forest Service, United States Department of Agriculture. $7.00. (Reviewed by* CARROW T. PROUT, JR., *Upper Darby, Pennsylvania.)*

Cotton is no longer "King" in the South. The southern pine is the reigning monarch and loblolly pine the regnant species. The wide range of adaptability, the productivity, and the varied usage of this regent of the southern pine has been recognized for many years. And because of its importance in the South, loblolly pine has been the subject of much intensive research. From early in this century until 1959, approximately 1,500 publications and many unpublished papers were prepared containing information on loblolly pine.

The need for bringing this array of material together was apparent. Students and managers of loblolly pine needed it. The task was staggering, but Wahlenberg did it. He reviewed; summarized; and, with his own comprehensive knowledge of the species, brought together in one volume the pertinent information on loblolly pine. From the statistics and research publications he produced a very readable and a very authoritative work, *Loblolly Pine*. It should be a valuable reference for years.

A look at the table of contents reveals the depth of treatment. The references are catalogued in the bibliography. Chapter 1 lists the problem encountered in management, the history of the use of loblolly pine, and its importance. Chapter 2, "The Species and Its Environment," begins with the origin of the name "loblolly" and enlightens the reader as to the range of the species and the factors of environment that influence its growth and development. Such factors as plant succession, physiography, moisture, nutrition, and the related influences of soils are discussed. Following this is an intimate glimpse of the growth needs and behavior of the tree in its component parts. A treatment of site quality completes this most interesting chapter.

In the succeeding three chapters of the book, "Protection," "Natural Regeneration," and "Artificial Regeneration" are covered rather completely.

Chapter 6, "Growth and Yield," presents a foundation upon which management of immature timber, management of mature timber, and management for other purposes, the subjects of succeeding chapters, are based. Properties and uses of loblolly pine are well covered in the last chapter of the book.

In addition, a complete appendix of tables useful to the grower and manager of loblolly pine is included.

Some variations of thought may be picked out of *Loblolly Pine*. It is to the credit of the author, however, that he reported the results of research and the variations of the opinions of foresters working with the species rather than selecting results to "prove" an idea he may have had. The personal opinions of the author are given no apparent priority over the research and opinions of others. The material is presented in an unbiased manner. Readers and students are able to make interpretations with the most authoritative help available in a condensed form.

The results of future research in loblolly pine will in no way detract from the value of this book. It will merely add to the knowledge stored in this work.

Wurzelatlas Mitteleuropaeischer Ackerunkraeuter und Kulturpflanzen. BY LORE KUTSCHERA. *574 pp. illus., refs., index, index of plants illus., 1960. DLG-Verlags-GMBH, Frankfurt am Main, West Germany. DM 90—(approximately $22.50). Reviewed by* H. KOHNKE, *Lafayette, Indiana.)*

Altogether too little is known about the growth habits of roots and of the effect of the soil on their development. We are fortunate to have Lore Kutschera's "Root Atlas" to get better acquainted with this important subject.

More than 250 carefully prepared drawings show the morphology of roots of crop plants and weeds. The similarities of the roots within the various botanical families become evident, as well as the response of roots to the environment. Ecological factors, growth pattern, and associated plant species are mentioned in connection with each root picture. An extensive chapter is devoted to a general discussion of root growth and the factors affecting it.

The "Root Atlas" by Lore Kutschera is a valuable contribution to conservation literature.

Land for the Future. By MARION CLAWSON, R. BURNELL HELD, AND CHARLES H. STODDARD. *570 pp., index, appendices, 1960. The Johns Hopkins Press, Baltimore 18, Maryland. $8.50 (Reviewed by* AYERS BRINSER, *Boulder, Colorado.)*

Resources for the Future has undertaken to establish what is in essence a series of benchmarks from which calculations of future resource needs may be estimated. The ostensible purpose is to assemble the present known data on specific resource issues in comprehensive volumes which attempt to organize that data in a pattern that establishes a point of departure for analyzing alternative policies and for projecting future demands. In this category are Ackerman and and Löf's *Technology in American Water Development*, Perloff, Dunn, Lampard and Muth's *Regions, Resources and Economic Growth*, and Clawson and Held's *The Federal Lands*. To aspire to the role of a latter day Diderot in what has been called this age of analysis requires something more than confidence in the independent validity of "facts." There is also the more pressing present need to establish criteria of relevance in a world of emerging contingencies. It is to this second issue that these volumes have addressed themselves most rigorously. Their success in holding to this line of attack is the primary measure of their usefulness.

Observed from this point of view, the latest volume in this series, *Land for the Future*, is a successful enterprise. While there may be grounds for questioning the organization and values assigned to the data, the focus on the relevant issues is precise and cogent. The authors state the fundamental question of land management policy, "How can the all but insatiable wants and needs that we have come to regard as only our due in the American way of life be reshaped into designs better balanced for attainment of ever higher standards?" This suggests that the real issue in resource management policies is not simply a matter of how to increase the gross national product, but rather how to enhance the content of the gross national product to improve the level of living. Clearly that objective requires establishing some equation of normative values with standards of efficiency rather than merely putting norms to one side as one proceeds with the efficiency calculus. They hasten to admit that, "To questions such as these there can never be final answers."

To recognize this ultimate complexity of the problem of estimating future resource needs opens the way for a broader and more significant analysis of the alternative choices for shaping the future.

On the score of efficiency the greatest weight is given to economic efficiency, although the concepts of biologic efficiency are by no means ignored. "Solutions [to resource problems] will depend, primarily, on a clearer understanding of unalterable conditions and limitations ordained by nature, the dictates of climate in given locations, and by the not inexhaustible store of physical resources to be put to use." In this study there is no question of defining efficiency too narrowly, but rather that on occasion the two definitions are confused. In the end, however, the real issues are not restricted by either the limits of what is defined as the final reality by economics or ecology. As it is stated here, ". . . beyond that, and even more difficult to calculate in terms of the future, is the human potential. There is no useless land. The ultimate resource is the resourcefulness of man."

This point of view is implemented in the opening discussion of the land in time and space. Beginning with the statement, "Ideally, use of land should be studied according to the degree of consciousness of the decisions underlying its management," the authors go on to point out that the current definitions of land ignore the essential interdependence between the area of land and the level of use in estimating the future product of land. For example, between 1850 and 1955 the area in grazing and forest land was reduced by half. But while the total area as defined by vegetative cover diminished, the area devoted to these uses in the management and hence productive sense, increased. Thus, past experience indicates that for the relevant planning horizon the critical factor is not land area but the availability of resources to invest in management and the advances achieved by both the physical and social sciences.

It is significant that the methodology of analysis used here is one of making estimates of future demand up to the year 2000 based on assumptions of the course of present forces. This is not a forecast of what is most likely to happen, nor is it usually a projection based on observed trends extended into the future. In this way the methodology of the study is adapted to the concept of change as the critical aspect of land use. "The chief concern of this study is to examine existing conflicts [in land use], to assess in terms of present realities and future prospects the most necessary and valid courses of change, and to suggest policies that may serve to minimize the impact of competing demand and need."

The opening chapter sets the frame of reference for the specific analysis that follows. Perhaps the clearest indication of the change in attitude toward land use that the growth of the American economy has forced upon us is the order of the succeeding chapters. Unlike the conventional pattern of such studies where they are relegated to the end as a kind of afterthought, "Urban Uses of Land" and "Land for Recreation" head the list of specific studies. In all cases the estimates of need for the year 2000 rest on a reasoned set of basic calculations. These are first, that population will reach 240 million in 1980 and 310 million in 2000; second, that personal income per capita will be up 125 percent (to $3,660 in terms of 1955 dollars) by the latter date; third, in that period gross national product will increase from the 1955 level of $392 billion to $1,670 billion (in terms of 1955 dollars). In the light of this rapid growth, how important is it that the area of land is fixed? How rapidly, and by what means will increases in productivity accommodate this growth? In this pattern of change, what conflicts and friction in the flow of factors to and from land resource activities can be foreseen and avoided?

In the case of urban land, while it is the most active growth point, the area to be consumed does not threaten the resource base of the economy. The real threat is rather one of economic inefficiency spawning heavy social costs, and the misallocation of space as a critical resource. An anticipated growth of 141 percent in urban area between 1950 and 2000 is an increase of only 24 million acres out of a total of 1,904 million acres in the continental United States. The significant point for resource management policy is that these acres will absorb the bulk of our resources of labor and capital. They will support the overwhelming majority of the population. By the year 2000 there may be 150 million new people in urban areas outside the central city. This will require an investment of $1,500 billion in urban property alone.

It should be obvious that in the over all pattern of resource use it is essential that urban growth should proceed with a maximum of economic efficiency and that it follow a design that will make the greatest possible contribution to the amenities of life. Here the resource issue is not one of land area, but rather one of guiding resource investment to produce the optimum quantity of goods and satisfactions of the optimum quality.

The "view with alarm" that 24 million acres needed for urban development will encroach on irreplaceable agricultural land is met with three persuasive answers. First, the growing cities will provide the essential

market for the products of farms and forests. Second, the output of farm and forest products from the remaining land will more than meet this demand. Finally, land in urban uses has the highest economic value for the whole society.

It would have been useful if the demands of urban growth on the supporting hinterland had been incorporated in this chapter. The most important of these are recreation areas, watersheds, and land for transportation. Instead, they are considered in the chapters on recreation and in the chapter on "Miscellaneous Uses of Land." If this data and analysis had been included in the chapter on urban land the essential conclusions might have remained unchanged, but the character of the process of development and the range of competing and complementary land uses might have emerged with significant modifications.

The estimates of need for recreation land are confined to public areas for outdoor recreation. If for no other reason, this limitation was forced on the authors by the poverty of data on other types of recreation. The requirements for 2000 are set at 95 million acres, an increase of 107 percent over the 46 million acres used for public outdoor recreation in 1950. From this it is clear that land now devoted to forestry and agriculture as well as some of what is now regarded as waste land must be transferred to recreation if the need is to be met. Furthermore, the investment required for this expansion will be a significant portion of the public budget; an increase from $14 billion in 1956 to $88 billion in 2000. An expansion of this magnitude assumes a real public concern with the quality of the content of living. If this allocation is to be made efficiently, then recreation can no longer be looked upon as residual claimant for public investment funds but rather as an investment opportunity to be weighed on the same scale with other opportunities to use public funds productively.

In this chapter there is an apparent confusion between the concept of demand for recreation in an economic sense and projections of recreation resource use. Recreation is an economic activity characterized by rapid taste changes, weakness of conventional market indicators such as prices, technological innovation and uncertainty of consumer responses. For example, within five years the development of the motor boat has exploded the requirements for water recreation areas while creating major frictions between various types of recreation uses of the same areas. As another source of uncertainty, levels of income and costs may have less influence on developing recreation activities than income expectations. The supply of recreation opportunities has a major influence on shaping consumer tastes. These and many similar factors make estimating future recreation resource requirements a hazardous if not thankless task.

For this reason the lament of the authors that there is insufficient historical data on recreation activity on which to base extrapolations of future needs would seem to be misdirected. Given the rapid rate and uncertain direction of change in the use of recreation resources, to base future estimates on past experience is like driving a car by watching the rear view mirror. The greater the weight of the past in the estimates for the future the greater the chance of error in establishing guide lines for future investment.

The salient calculation in the chapter on agricultural land is the prospect of the decline in the requirements for such land, an estimated reduction of 20 million acres from 1950 to 2000 or a drop of 4 percent. Of all of their estimates the authors put forth this one with the least confidence. They base their assumption on the fact that major changes in farming will come from the substitution of other factors for land and from changes within agriculture rather than factor shifts between agriculture and the rest of the economy. Here the emphasis is on the demand for agricultural products rather than on the behavior of the supply function. It may well be the latter, however, that is the more significant factor in determining future land requirements.

The estimates for forestry follow the pattern established for agriculture; greater intensity of management with a posible decline of 29 million acres in forest land between 1950 and 2000, a loss of 6 percent. This section draws heavily from earlier studies. Perhaps as a consequence of this reliance on past analysis, here land area appears as a more significant factor than process of land use. In this respect the frame of reference is inconsistent with the general design stated and defended as the proper line of attack in the chapter on methodology.

An example of this is the position that the major problem to be solved in the future is that of the small woodlot. This is a conclusion from the fact that such a large percentage of land in forest cover is in this type of ownership. The conclusion concerning the significance of this land for future forest production ignores the facts of economic life. In the first place, most woodlot owners derive a higher net marginal revenue from the factors at their command by employing them in other activities. Not only are the opportunity costs high, but the uncertainty costs for owners of this kind are even higher. Furthermore, the price schedules and market structure faced by small sellers is anything but favorable. They are denied the opportunities of gaining economies of scale and the advantages of vertical integration open to woodland owners who are also processors of wood products. For these, and other reasons as well, it is hard to see why investment resources should be diverted to this area where the marginal revenue is low and at the same time adequate supply can be produced from holdings with sufficient size to return full value for the factors employed. The small woodland owner may or may not present a socio-economic problem. The small woodlot is not, in the foreseeable future, a major problem area from which we will have to secure our wood supplies.

The discussion of grazing land follows the design of the chapters on agriculture and forestry. An estimated decline of 20 million acres in grazing land is anticipated between 1950 and 2000. This would be a drop of 3 percent. Here again the cause of the shift is assigned to greater intensity of use. The critical part that water plays in the use of much grazing land is noted but not subjected to a thorough scrutiny. This may account for the fact that little attention is given to the economic possibilities of extensive management. By viewing grazing as an area embracing the Great Plains rather than as an economic enterprise, the possibilities of resource allocation and livestock production in areas such as the Southeast are left out of consideration. If the question to be analyzed were in fact, land for grazing, as the chapter title indicates, then it would have been necessary to consider these alternatives in estimating needs for the year 2000.

Under the rubric, "Miscellaneous Uses of Land" are included land for transportation, water and wildlife management, mineral production and so-called waste land. In the case of the last two a decline of 29 percent or 25 million acres is forecast between 1950 and 2000. In the first three categories there would be increases of 20 percent, 100 percent and 43 percent, respectively. While water requirements show the largest percentage gain, the actual increase in area amounts to but 10 million acres.

The final chapter, "Land for the Future," is a useful summary of what has gone before, placing the whole future pattern of land use in a perspective that again

(Continued page 180, column 3)

Current Literature Briefs

Forages

Forage Fertilization Pays. 44 pp., illus., 1961. The American Potash Institute, Inc., 1102 Sixteenth St., N.W., Washington 6, D. C. (Single copies free.)

This booklet is composed of selected studies conducted by the various State colleges of agriculture and experiment stations. It describes well the increased yields of forage obtained through proper fertilization practices.

Composition of Dehydrated Forages. *Binger, Thompson and Kohler.* 20 pp., refs., 1961. Technical Bulletin No. 1235. U.S. Government Printing Office, Washington 25, D. C. $0.05.

Grassland-Livestock Handbook. 47 pp., ninth rev. ed., 1960. American Grassland Council, Department of Agronomy, Pennsylvania State University, University Park, Pennsylvania.

This booklet in question and answer format relates information concerning production, storage, and utilization-through-livestock of the grasses and legumes of North America.

Land Management

Soil Erosion by Wind and Measures for Its Control on Agricultural Lands. 88 pp., illus., refs., 1960. Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, Rome, Italy. $1.00 (5s).

The final draft of this booklet was written by J. S. Robins, based on material from numerous sources. The first three sections are devoted to occurence, the process, and measures to control soil erosion by wind. The last two sections concern soil erosion by wind in lesser developed countries and legislation and collective action to control wind erosion.

The Tennessee River Gorge, Its Scenic Preservation. 104 pp., illus., 1961. $1.00. Tennessee State Planning Commission, Cordell Hull Building, Nashville 3, Tennessee.

Comprehensive Plan for Land Use Development of Melton Hill Reservoir. 82 pp., illus., 1960. $1.00.

These two publications deal with localized geographical areas, but the general land use problems with which they deal are of national concern, i.e., reservoir shore line land use planning and scenic preservation.

Using Crop Residues on Soils of the Humid Area. *W. E. Larson* and *O. W. Beale.* 14 pp., illus., 1961. U.S. Government Printing Office, Washington 25, D. C.

Forestry

Planting Black Walnut for Timber. *Arthur G. Chapman.* 6 pp., illus., 1961. U.S. Government Printing Office, Washington 25, D. C. $0.05.

Key to Important Woody Plants of Eastern Oregon and Washington. *Doris W. Hayes* and *George A. Garrison.* 213 pp., illus., index, 1960. Agriculture Handbook No. 148. U. S. Government Printing Office, Washington 25, D. C. $2.00.

This book contains an individual description and line drawing of each of the more common woody plants in the area and is prepared as a shrub key based on twig and leaf characteristics. It is written in layman's language.

Forestry and Forest Industry in the U.S.S.R. 92 pp., illus., 1961. U. S. Government Printing Office, Washington 25, D. C.

This report of forestry practice in the Soviet Union is the result of a seven-man study tour of foresters from the U. S. The U. S. forestry team traveled some 6,000 miles within the U.S.S.R. in a 30-day, on-the-ground study of problems, procedures, and progress in forestry there.

Releasing Conifers in the Lake States With Chemicals. *J. L. Arend* and *E. I. Roe.* 22 pp., illus., 1961. Agriculture Handbook No. 185. U.S. Government Printing Office, Washington 25, D. C. $0.15.

How to get rid of brush and low value hardwoods that are interfering with growth of pine trees is the theme of this pamphlet.

General Interest

Bibliography of Strip-Mine Reclamation, 1953-1960. *Kenneth L. Bowden.* 5 pp., mimeo., 1961. Department of Conservation, University of Michigan, East Lansing. (Single copies free)

Our Resource Situation and Outlook—Public Policy and Individual Responsibility. *Joseph L. Fisher.* 10 pp., 1960. Reprint 22. Resources for the Future, 1775 Massachusetts Avenue, Washington 6, D. C. (Single copies free)

(Continued from page 179)

emphasizes not only the contingency of estimates but also the importance of analyzing the elements of change as more significant than acres alone. A final section entitled "Beyond 2000" is essentially a verbal interrogation mark, and rightly so. If we have learned nothing else from recent studies of resource use it is that shorter planning horizons are not merely more safe, they are also more useful. As we have learned to construct more sophisticated methods of analysis, the overwhelming importance of timing and the role of uncertainty have emerged as decisive. The authors recognize that the central problem in resource management is not to plot a design for the distant future, but rather to start from a rigorous assessment of what is presently observed to enable us to move in the direction that seems to be desirable. And as we move, to create the possibility of taking full advantage of changes in direction, both as we condition change and as change is forced upon us.

To conclude that *Land for the Future* is a useful study is to restate the obvious. It is a substantive point of departure for continuing study and analysis of land resource issues and policies. Its greatest virtue is the close attention to the data, attention that is both comprehensive and rigorously conceived. To deal responsibly as this book does with the questions of how much, where, and when is a real contribution to an effective understanding of resource problems. Equally important is the emphasis on the processes by which land resources produce goods and services to satisfy human wants. Any attempt such as this to cover such a broad spectrum of activity would obviously raise questions about the validity of the data and the consistency of the analytical framework, but these caveats emphasize the value of the study. They establish the fact that the data and analysis are presented with that detail and force that makes criticism possible.

Modern Insecticides and World Food Production. *F. A. Gunther* and *L. R. Jeppson.* 284 pp., illus., refs., index, 1960. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. $8.50.

This book by two members of the Citrus Experiment Station of the University of California is not written for the specialists in the fields of economic entomology and the chemistry of insecticides, but is designed to provide a general and comprehensive insight into the whys and wherefores of modern insecticides and acaricides, the problems of, and arising from, their use.

Notes from the Field

A Mobile Double-Tower Sprinkling Infiltrometer

EDD D. RHOADES

RESEARCH PERSONNEL and conservation technicians in studies and application of management practices frequently must evaluate the effect of such practices on water intake. Many methods and techniques have been used to measure total infiltration, none of which satisfactorily meet all specific situations.

One of the most reliable ways of making a true evaluation of water intake is by gaging field-size plots. Such installations require placement of recording raingages and runoff measuring structures on each plot. Unfortunately, it is impractical to place such costly equipment in each of the many complex situations that may exist. Under natural rainfall conditions, many years and large expenditures of manpower and funds may be required to gather sufficient data. This has led to the development of numerous types of infiltrometers whereby, on small areas, time, amount and intensity of simulated rainfall can be controlled. Under such simulated conditions, several soil treatments or management practices may be completely evaluated within a few years.

Increased demand in recent years for more information on infiltration as related to land management led to the construction of an improved version of a mobile sprinkling infiltrometer. The original device was developed by W. D. Ellison and associates with later modification by Barnes and associates in Wyoming.

Construction of Infiltrometer

The infiltrometer described in this article is similar in many respects to that described by Barnes and Costel (1). It consists of a two-tower unit mounted on a trailer, which can be moved from site to site by a pickup truck (figure 1). The unit is extremely mobile and can be used on almost any site where a regular pickup truck may be driven. The towers are mounted on each end of the trailer (figure 2) so that two infiltration rate determinations may be made simultaneously. Each tower is mounted so it can be moved in and out, or swing from one side of the trailer to the other. Thus, each tower may be centered over three consecutive plots, permitting a total of six infiltration tests to be made at each trailer position. The towers are equipped with lateral and longitudinal leveling screws which permit each tower to be plumbed.

The towers are constructed so that they can be lowered for moving from one site to another. They are made of lightweight aluminum and are 9.0 feet long and 50 inches in diameter. Each encloses a full cone spray nozzle, which is centered approximately 6 inches below the top. Also, a 48-inch diameter, circular dripscreen is mounted in the tower (figure 3). The dripscreen consists of an iron frame circle, covered with 1-inch mesh chicken wire, which is then covered with two thicknesses of muslin. The cloth is pushed into each opening of the wire to form a pocket about one-half inch deep. Heavy rug yarn, about two inches long, is threaded into each pocket and knotted on the top to prevent the yarn from pulling through the muslin.

Water spray from the nozzle is applied to the dripscreen; drops form on the ends of the yarn and fall approximately 10.5 feet to the ground. The arrangement produces uniform drop sizes over the entire 12.5 square feet under the dripscreen. Drops from the yarn used in the unit described averaged 5.31 mm. in diameter. The drop size may be decreased by using a smaller yarn, and the number of drops per unit area could be increased by using a smaller mesh wire in constructing the dripscreen. The distance between the nozzle and the dripscreen may be adjusted to obtain the best distribution pattern for a particular nozzle, at a given water pressure. As the pressure changes, the pumping rate changes in a like manner, and the distance between nozzle and dripscreen needs to be adjusted to give a uniform distribution of water.

The six test areas around the trailer are determined immediately after spotting the unit to prevent excessive trampling. The actual test area is formed by driving a concentric ring into the ground at each of the six locations if that many tests are desired. The ring is 28.26 inches in diameter, or 4.356 square feet (.0001 acre), and may be 6, 8, or 10 inches high, as desired. To facilitate collecting runoff, an enclosed spout or hood is welded over a 1.5-inch by 12-inch slot in the side of the ring. In moist soil, the ring is easily driven into the ground, whereas in hard, dry soil the ring is weighted by a special frame attached to the bumper of a truck, and driven into the soil with a sledge hammer. Soil disturbance along the edge is minimized while driving the ring into the ground, by the uniform distribution of pressure and the sharpened edge of the ring. A special template is used on top of the ring to transmit weight, and to pre-

Figure 1. Mobile double-tower rainfall simulator or sprinkling infiltrometer in position for highway movement.

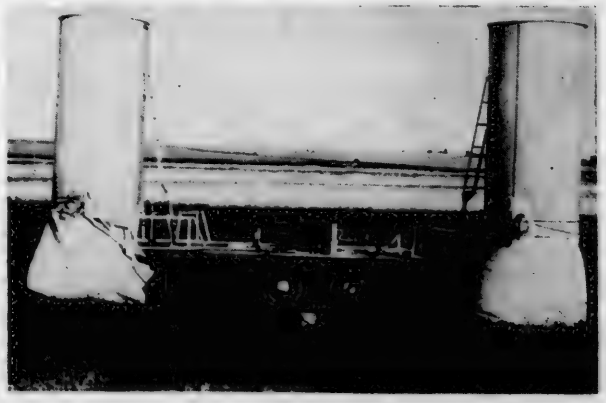

Figure 2. Infiltrometer with towers upright, ready for field test. The nozzle is located in the center of the tower near the top. The dripscreen is mounted inside the tower below the nozzle. Canvas skirts are used to protect the plot from wind. Runoff rings are centered under the towers.

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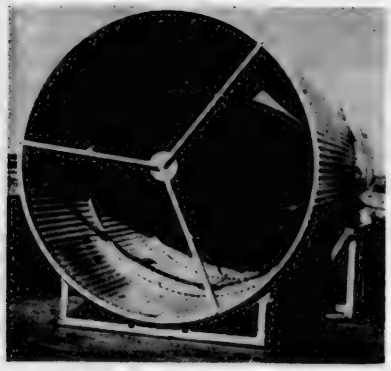

Figure 3. Top of tower in a lowered position, showing nozzle, dripscreen, and angle bracing.

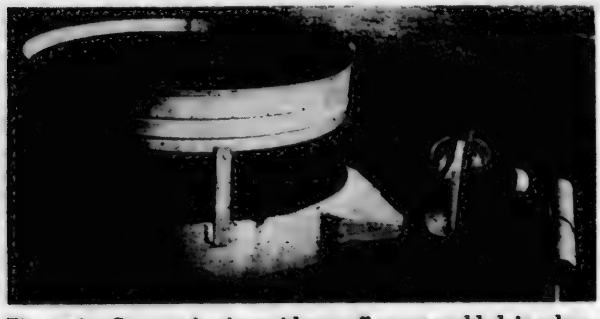

Figure 4. Concentric ring with runoff spout welded in place. The detachable pan on top is used for determining rate of water application or intensity. Water is withdrawn as runoff from the plot or pan into the jar. At specific time intervals, the water is measured in the raingage tube.

vent deformation of the top of the ring. This template is removed after driving the ring to the proper depth. The runoff spout is always placed downslope, and a slight excavation is necessary to permit the runoff spout to fit in place. A tower is centered over each ring and locked in position during each test.

In order to maintain a constant head on the water, it is drained by gravity from a 350-gallon tank on a truck to a float-valve controlled container. It is then pumped under constant pressure to each spray nozzle. Simulated rainfall intensities may be varied from 1 to 6 inches per hour by changing pumping pressure or by changing nozzles. With towers centered over the rings, an area of 12.5 square feet, or a 48-inch diameter area is sprinkled. This provides a 10-inch buffer zone around the outside of the test area to counteract lateral movement of water in the soil.

A suction pump is used to transfer runoff water from the spout to a container. The difference between rate of runoff and the known rate of application provides information on the infiltration rate. Lag due to time of travel on the plots is negligible. Rates of application are determined before and after each test by using a calibration pan placed over the runoff ring (figure 4).

Application rates sufficient to produce runoff within approximately 30 minutes are generally applied. Infiltration tests are usually run for 1 hour or more. Duration is generally such that a leveling-off effect is indicated. It has been the practice to make an initial test for 1.5 to 2 hours and another 24 hours later while the soil is near field capacity. To aid in evaluating infiltration studies, soil moisture determinations are made immediately prior to each test. It is pointed out that the soil moisture content at the time of making an infiltration rate determination will affect the intake considerably. In addition, bulk density, textural composition, and soil cover determinations are made.

The unit has been used through one season and it is believed that many useful measurements on various combinations of soil, cover, and management can be reliably made.

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Irrigation Extension and Land Drainage in Israel

NORMAN J. ROSENBERG

HISTORY HAS SHOWN that the Euphrates Valley and the Valley of the Nile were among the regions in which irrigation was first practiced. Palestine, located on nearly a straight line between these two areas, has no long history of irrigation.

The water sources of Palestine are largely subterranean. Her rivers are small and usually deep-cut. The northern part of the country receives heavy winter rains and cannot be considered an arid region. These winter rains, typical of the Mediterranean climate, are sufficient to permit the growing of a wide variety of winter vegetables, small grains and forage. Summer crops can be grown in the North on stored winter water where fields have been clean fallowed.

The winter rains are a mixed blessing for heavy flooding of farm and urban areas occurs almost every year. Much of the alluvial land of the major valleys suffers from high water tables maintained by flow through the limestone hills. Frequently these water tables are associated with high soil salt content.

Thus, the historical incentive for the development of irrigation has long been less strong in Palestine than in surrounding regions. Modern Israeli agriculture, however, cannot be completely dependent upon the winter rains. The growth in population with its concomitant demand for foodstuffs requires an intensive agriculture, based in large measure upon irrigation. Water sources are limited in Israel and the limiting factor in the development of Israel's agriculture today is water, not land. Unit costs for water are high since much of the irrigation water is applied by sprinkler, requiring pumping to high elevations. Delivery of water to outlying points and hill settlements adds to the overall distribution costs. Fuel and machinery come largely from abroad and require the outlay of foreign currency. Until such time as sea water can be "sweetened" economically, the rational and efficient use of its water resources will remain one of Israel's greatest problems.

This article describes work of two groups, the Field Service of the Water Authority (a governmental agency), and the Drainage Department of Water Planning for Israel, Ltd. (a corporation in which the Israeli government is one of the major stockholders), and their methods of dealing with water problems. The methods developed by these groups have a local character, yet it is conceivable that some of their ideas may be useful in countries

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where water problems are now severe or in those areas where water problems are anticipated.

The Field Service of the Water Authority

This group functions in conjunction with local councils (equivalent to county authorities) in the dissemination of information and services related to proper irrigation. It was founded in the Jordan Valley region about 8 years ago and is now active throughout the entire country. The group is led by M. Boaz, an American-trained irrigation engineer.

The staff in each county is headed by an agronomist, and also includes a trained laboratory technician and a field extension specialist. The agronomist divides his time between supervision of the laboratory and field work. Headquarters in each area is the local laboratory.

In each county where the Service is established, farmers pay for part of its financial support through their local taxes. When a new settlement applies for assistance, a soil survey is made encompassing those fields under irrigation and those which are likely to be irrigated when conditions allow for expansion. Profiles are inspected and interpreted in the light of possible irrigation hazards. Soils are tested by routine characterization procedures, and parameters of particular interest to irrigation such as field capacity, wilting point, bulk density, available moisture, and soil texture are determined.

Estimates of daily and seasonal moisture requirements are made for particular crops. Where results of full scale irrigation experiments, as conducted by the Agricultural Experiment Station at Rehovoth, are available for a given crop, these serve as the basis for planning. With this type of information and a knowledge of the specific soil characteristics of the area, a practical irrigation plan can be worked out with the farmer. The final plan leaves plenty of room for the farmer's preferences in irrigation method.

Persons responsible for irrigation in a particular settlement are made aware of the need for an adequate, but not excessive, supply of moisture. Common to irrigators the world over is that maxim of questionable verity "some water is good, so more water is better." This is a most difficult belief to change among the populace.

Day to day contact is maintained with participating farmers through a system in which, after given some instruction in the art of soil sampling (and it is an art), the farmer keeps constant check on soil moisture conditions. Moisture samples are taken as often as the field extension agent feels necessary and are delivered immediately to the laboratory. As soon as the moisture samples have been analyzed a recommendation is telephoned to the farmer to hold off, hurry up, or stay with the irrigation plan in progress. A postcard form will reach the farmer, usually with the next mail delivery, showing the simple "available moisture" calculations and the reason for the recommendation.

This approach can obviously not be an end in itself. Rather, it serves to educate the irrigator and make him base his planning on fact rather than whimsy. Eventually the settlements will purchase the inexpensive equipment needed to supply this service to themselves, while the facilities of the laboratory can be used for research on the many other pressing problems in their regions.

In addition to the local three-man staffs in each area, the Service employs specialists who deal with the more technical aspects of irrigation equipment by testing systems and components and advising both farmers and manufacturers of the results. Selecting and testing soils for citrus plantations, extension work in the use of saline and alkali-hazard waters, and reclamation of alkali soils are also among the problems handled by the group of engineering and soil science specialists who service the local areas.

Often it is necessary to join forces with other agencies in the solution of problems where only by combined efforts can effective work be done.

The Drainage Department of Water Planning for Israel, Ltd.

Drainage work is not new in Israel. During the last half century much has been done to eliminate the vast swamp areas which hampered the work of the early settlers. This drainage was aimed at eliminating the malaria problem.

At its inception in 1952 the Drainage Department, directed by B. Z. Kinori, an engineer trained in Czechoslovakia, undertook a survey of the drainage and flooding problem in Israel. Its staff, in consultation with foreign and local authorities, arrived at an approach well suited to the economics and soils of Israel. This approach recognized the difficulties involved in attempting to drain large areas of the tight, ultra-fine textured, alluvial soils by conventional networks of tile, shallow ditches, or moles. Instead, a geologic approach, that of locating and diverting sources of underground water has been tried with some success.

A case in point illustrating the organic relationship prevailing between the Drainage Department and the Field Service is found in the Upper Galilean settlement of Shamir. There, an area in border irrigation and planted to apple trees was found to be seriously affected by alkali. Water infiltration was exceedingly slow, and the trees were set back in their development. After the seepage point was found and its waters diverted, the soils specialists of the Field Service were able to propose a suitable reclamation scheme. Gypsum was applied and the soil was leached with the excellent quality water found in this region. Water samples of the leachate flowing into the tile drain, which was lead through the low end of the field, showed a striking increase in sodium content. Infiltration rates increased. Within a season the hydrophytic vegetation of the area disappeared and grasses intolerant of moist conditions began to cover the intertree areas. The trees themselves are not likely to make large yields after the setbacks suffered, but chances for increased soil productivity to be reflected in succeeding crops are good.

This report has illustrated briefly some of the approaches and methods worked out by the corps of eager agriculturalists and engineers faced with the tremendous problem of making Israel's agriculture pay its way. In a country of limited land and water resources, much depends on their success.

Germination of cotton is hampered by spots of alkali concentrations in the soil in the Bet-Shan region of Israel. Fair germination is evident in the background.

BASAL SEEDING OF ROAD CUT SLOPES

C. L. VEATCH AND PAUL TABOR

A NEW METHOD of vegetative stabilization of steep road cuts has been developed in the Settingdown Creek subwatershed near Cumming, Georgia. It consists of seeding or planting adapted erosion resisting vegetation in the loose weathered material that has accumulated at the base of road cut slopes. This technique follows one of the natural methods of roadbank stabilization described by Veatch and Tabor (1). It is effective and easy to apply. Soil Conservation Service technicians of the Forsyth County Work Unit of the Upper Chattahoochee Soil Conservation District who made the first plantings suggest that seeding or planting at the base of road cut slopes be called "basal seeding."

The first basal seeding was made in August 1956 on a thousand linear feet of road cut slope. This cut varied in height from 3 to 15 feet and had a cut-slope gradient ranging from 1.5:1 to 2:1 (base to altitude). A commercial fertilizer with a nutrient analysis of 4-12-12 was broadcast over the strip of loose soil above the road ditch at the rate of 1000 pounds per acre. A hand rake was used to work the fertilizer into the soil. A seed mixture of 50 pounds of sericea lespedeza *(Lespedeza cuneata)* and 10 pounds of weeping lovegrass *(Eragrostis currula)* per acre was then sowed over the fertilized area. Small areas on which thin stands existed were reseeded and fertilized the following April. An effective strip of vegetation was produced by the fall of 1957. During the following winter, this band of lovegrass and lespedeza caught and held the soil material that eroded from the slope above. The new strip of loose material that accumulated was fertilized and seeded in the spring of 1958, and a third one in the spring of 1959. The initial treatment of the second and third bands was similar to the first planting. Ammonium nitrate at 200 pounds per acre was applied over the seeded portion in 1958 and 1959.

The third seeding finished the establishment of vegetation on the road cut slope. No more eroded material moved into this road ditch.

The total cost of seeding the three bands was less than complete treatment of similar banks where artificial seedbed preparation was required. Basal seeding does not require machine work and other artificial methods to prepare a suitable seedbed; freezing, thawing and gravity erosion prepare a good one.

Suitable cut slopes on an additional 25 miles of roads were treated in 1958 and 1959. Some plantings were made on steeper and deeper cuts. Effective vegetative strips have been established at the base of the banks in each test.

Plants other than lovegrass and sericea lespedeza have been used. They include Japanese honeysuckle, periwinkle (*Vinca*), crown vetch, bermudagrass and perennial sweet pea. Vegetative plantings of Japanese honeysuckle, planted alone and in the strip of weeping lovegrass and lespedeza, and fertilized annually for three years, are providing an excellent vegetative cover. A single row planted at 3 foot spacings in the loose soil at the base of a 10 foot cut has almost covered the bank in 3 years. A basal strip of sericea lespedeza and weeping lovegrass with a row of Japanese honeysuckle planted in the upper portion of the loose material may be all the treatment needed for many road cut slopes.

Generally, basal seeding is not advised for cut slopes which are less than 2 to 1. Slopes less than this may be completely treated at one time. On rush jobs where cost is not a limiting factor, basal seeding will probably be too slow. There may be some other limitations, but this method of roadbank stabilization shows worthwhile possibilities for use on steep road cut slopes where basal accumulation has occurred and where the cost of vegetative stabilization must be low.

T. K. Orr, conservation aide of the Forsyth County Work Unit, who supervised the basal plantings in the Settingdown Creek subwatershed has observed that tall fescue growing along the top of some road cuts is producing good stands of this plant in the loose material at the cut slope base. He suggests that a row of suitable native or introduced species planted beside and above some road cuts might adequately seed the basal area without additional planting.

The basal plantings of road cut slopes that have been made in the Settingdown Creek Watershed are attracting a great deal of attention. There is little doubt that this method will be extended to other areas. As this occurs, the methods and procedures used in these tests will undoubtedly be improved. There is a need for the development or adaptation of labor saving machinery for distributing fertilizer and lime and for light harrowing. This would further reduce the cost and the time required for basal seeding.

Paul Tabor is plant materials specialist with the Soil Conservation Service, Athens, Georgia. Prior to his retirement in 1960, C. L. Veatch was management agronomist with the Soil Conservation Service, Gainesville, Georgia.

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A basal seeding of weeping lovegrass with a second seeding made a year later in the accumulation of soil material above the first seeding.

Three successive seedings of weeping lovegrass made at intervals of 1 year have covered this slope completely.

IT'S NOT THE LAND THAT'S PECULIAR

T. W. PAWLOWSKI

FAILURE OF PEOPLE to recognize that the land base on which we live has certain limitations, whether they are measured in terms of alfalfa, pasture, corn, apple trees, industrial plants, private homes, septic tanks, or wells, is one of the real problems we face today. Carrying capacity is a characteristic of the land. In suburban development legal lot sizes as they are drafted from a survey of an area should not represent arbitrary determinants of carrying capacity. A greater knowledge of the land base and its limitations is needed and the time to acquire this knowledge is before the land is sold for intensive development. Seldom can problems be solved on a lot by lot basis. The problem in many instances is one that is peculiar to the whole area. It is an inherent problem of the land that lay dormant in its natural state until disturbed by man in his quest for living room and money.

An editorial in the *Meriden Record*, Meriden, Connecticut, dated March 10, 1960, stated in part: "It's a question of putting the horse before the cart. Soil tests should come first, not last, in the planning of subdivisions. This service is one which the city would profit by providing."

Dr. Albert E. Burke, formerly professor of conservation and geography at Yale University, made some interesting comments concerning this matter (1). He said, "We are building up our landscape in a desperately inefficient manner. Eighty percent of the people who once lived in the city have moved to the suburbs and these city-bred people tend to forget or simply don't realize that land has a most important characteristic, carrying capacity. Now that one-fourth of our total population is suburbanite, we are creating horizontal tenements in the country to take the place of the old vertical tenements in the cities."

In some suburban areas water can be "turned on" only during certain hours of the day. In many areas one of the major problems is the inability of the soil to handle septic tank wastes, especially when tanks are installed close to each other in soil simply not suited for their use because of its low permeability or high water table. The concern should not be the drilling of a well, but rather whether there is enough water available in the water-bearing sand and gravel in the area to handle well after well. Before one constructs a labor-saving, gadget-filled house in the country, something should be known about the land on which it is going to be built. The net worth of any property, whether farm, home, factory, shopping center, school or highway, is determined to some extent by the character of the land on which it rests.

Without doubt there are numerous ramifications of this problem of urban expansion but the very nature of the problem seems to be of concern to the soil conservation district program.

On the surface this problem would seem to have little to do with agriculture. Quite logically a supervisor of a soil conservation district might feel that urban sprawl problems are not the district's concern. However, other district supervisors may feel that the primary concern of the district is soil and water conservation and proper land use, regardless of who owns the land or how it is used.

The problems of urbanization have a similarity to the ones with which the district has worked, in that they deal with proper land use, but this use is complicated by the fact the problems are residential, not vegetative. Basic to all land use is a knowledge of the soils; this knowledge provides a key to the success or eventual failure of enterprises conducted thereon. The district and its technicians are best equipped to provide the needed help.

The soil surveys that some day will be available on a county-wide basis will be invaluable as a base for planning all facets of land use. With a soil survey as a guideline, homes with septic tanks would not be built on areas of impervious soils and their closeness would be limited in any area of questionable permeability. Areas in flood plains would not be developed into home sites. Homes on hill sites would be developed intelligently with forethought as to seepage problems and runoff. Such planning in site development would save the costs of expensive and temporary remedial measures.

The district, through its Soil Conservation Service technicians, provides services on a request basis and this same philosophy should continue with the non-farm interests in urban areas. Assistance should be limited to a consulting basis to provide information for citizen groups so that they may make sound and intelligent decisions with regard to land use and development in the community. Most communities have their own professionally trained people or can hire them to implement the recommendations made for proper land use. Therefore the district need not become involved in engineering decisions that are the province of private enterprise.

Soil surveys and basic soil research are the base from which guidelines can be drawn for town planning and zoning boards to direct the course of urban development within their individual town limits. The boards will need to become familiar with the soils of their area to enable them to make intelligent decisions as to appropriate land use.

Hill and Shearin (2) showed the limitations of soil series as related to possible urban development sites. They discussed drainage limitations, infiltration, flooding, bedrock conditions and stoniness, and the end product of these considerations, site rating. They stated, "Poorly drained and very poorly drained upland soils, such as Leicester, Ridgebury, Wilbraham, Menlo, and Whitman, are generally avoided as sites for urban development because of the expenses incurred in correcting drainage conditions. The filling in of low spots has been the most widely used means of altering such conditions. The danger that arises from this practice is that the former situation has not been corrected but merely covered up if the mantle of fill material is not sufficiently dry to provide adequate subsurface drainage around basement foundations and septic tank drainage fields."

With the more rapid expansion of land-use plans based on soil classification and land capability, and with a willingness to accept these determinations in the making of decisions, progress can be made. Many of our cities have master plans, but citizens are still unaware of the need of knowing more about the land base. Perhaps the *Soil Conservation Society of America* can render a service by heightening public interest in soils research and its application to the field of land development.

T. W. Pawlowski is area conservationist, Soil Conservation Service, with headquarters at Spencer, Iowa. At the time this paper was written he was work unit conservationist, Soil Conservation Service, Wallingford, Connecticut. This article is a condensation of a talk given by the author at an annual meeting of the Southern New England Chapter of the Soil Conservation Society of America.

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Soil Moisture in Bluestem Grassland Following Burning

GENE L. BIEBER AND KLING L. ANDERSON

This progress report on the effects of pasture burning on soil moisture is the result of studies conducted in Kansas. Water supply is the principal factor limiting plant growth on the prairie, therefore, knowledge of the effects of timing of burning on soil moisture is important if management is to obtain maximum yields.

AFTER COMPLETION of their studies Dyksterhuis and Schmutz (4) stated that the water supply was largely limited by the amount of water entering the soil. They considered mulch the primary factor in determining rate of infiltration of rain water and concluded that the most practical way to increase the soil moisture supply was through practices that allowed greater infiltration of precipitation. Studies by Duley and Kelley (3), Beutner and Anderson (2), Rauzi (7), and Hopkins(6) have shown the value of mulch in increasing water infiltration.

Since fire destroys mulch, the effect of range burning on soil moisture has also been studied. Aldous (1) observed that moisture levels were lower in burned than in unburned plots. He also found differences in soil moisture among plots burned at different dates, the earliest burnings showing lowest soil moisture levels. This caused losses in forage yields.

Hanks and Anderson (5) found that removal of old top growth and mulch by burning continued to have an adverse effect on the rate of water intake for many months after burning. After a heavy rain in the fall of 1955, they noted a significantly greater increase in soil moisture in the unburned check plots than in adjacent burned ones.

The purpose of the study reported in this article was to gain more detailed information about the effects of pasture burning on trends in soil moisture. Four different burning-date plots and an unburned check were included in each of two replications, all treatments being carried out annually. The burning treatments were: winter burned (about December 1), burned in early spring (about March 20), burned in midspring (about April 10), and burned in late spring (about May 1). The unburned checks were clipped each year at the time of late-spring burning to remove old tops so they would not be included as a part of current forage samples. The trial area was originally studied by Aldous (1) and later by Hanks and Anderson (5). It is a deep, friable, ordinary upland range site, covered by true prairie vegetation in excellent range condition.

Soil moisture readings were taken with a neutron moisture gauge on 14 different sampling dates throughout the growing season of 1959. These readings were taken each 12 inches to a depth of 5 feet. This made it possible to check any fluctuation in soil moisture that occurred during the growing season.

Differences in soil moisture were noted on the different sampling dates, at the various depths, and for the different burning treatments. Soil moisture levels were high in the spring, declined during the summer, and increased again after fall rains began. Major fluctuations in soil moisture occurred during the growing season at the 1- and 2-foot depths. Gradual declines in soil moisture throughout the season were found at the deeper levels. These declines continued in most plots even after fall rains had begun. Figure 1 shows fluctuations in soil moisture at the different depths in an unburned range; this may be compared with the late spring burning in figure 2 and with averages of winter, early spring, and midspring burnings in figure 3.

The check plots and those burned in late spring were significantly higher in soil moisture than were those burned earlier, while plots burned in the winter had significantly less soil moisture than the others.

In early October, water intake after about 3 inches of rain appeared greatest on the unburned check plots. However, earlier in the growing season after two rainy periods, the study showed that water increases in soil varied. In July, after about 2.5 inches of rain, the midspring burned plots increased most in amount of soil moisture. In September, the late-spring burned plots had greatest soil moisture increases following some 3.5 inches of rain. In general, differences in soil moisture were greater among sampling dates than among treatments.

Forage yields in 1959, as in previous years, were largest on the unburned check plots and yields from those plots burned

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Contribution number 687, Kansas Agricultural Experiment Station, Manhattan, Kansas.

Figure 1. Total moisture in soil under unburned bluestem range, by foot of soil on various dates in 1959.

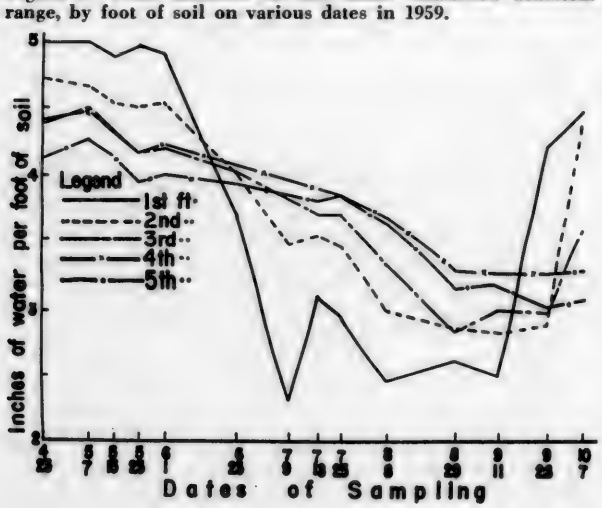
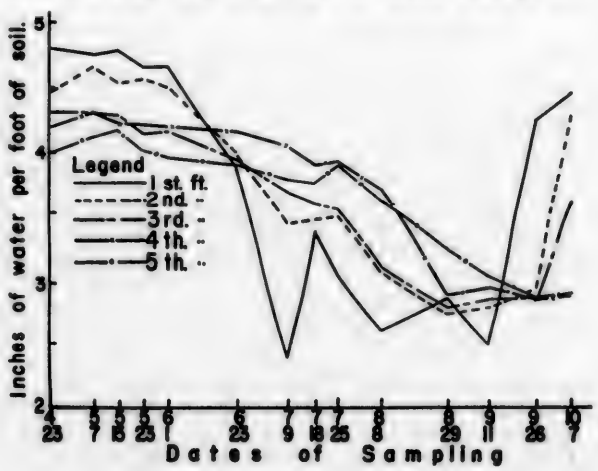


Figure 2. Total moisture in soil under bluestem range burned annually on May 1, by foot of soil on various dates in 1959.



in late spring ranked second. It can, therefore, be assumed that the unburned plots and those burned late lost more water because of greater transpiration. This may explain their somewhat smaller apparent soil moisture increase in July.

Loss by runoff probably was not much of a factor in these studies in 1959 because the rains were all fairly gentle and the rate at which they fell did not appear to exceed the infiltration rate on any plot.

Additional access tubes have been installed in the plots discussed here to permit more complete sampling of moisture levels for it is planned that this study be continued over several seasons.

The following tentative conclusions can be made concerning pasture burning and soil moisture in the Flint Hills region:

1. Early burning tends to reduce moisture content of the soil.
2. There is no significant difference in soil moisture between unburned plots and those extremely late in the spring.
3. Soil moisture declines as the growing season advances, the greatest declines and the widest fluctuations occurring in the upper 2 feet of soil. Declines at lower levels are less rapid and more gradual, and soil moisture levels do not rise with the coming of fall rains as they do in the upper 2 feet.

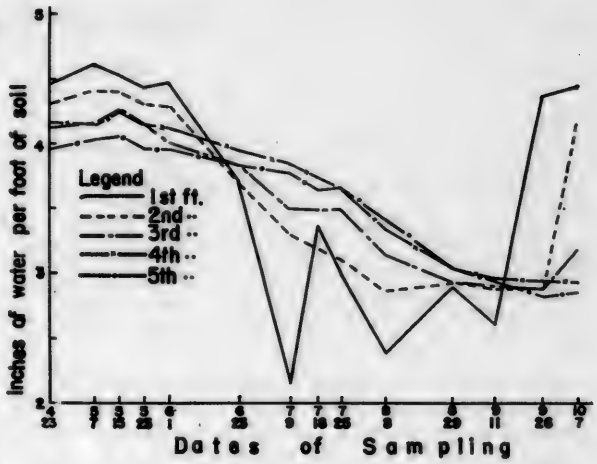


Figure 3. Average total moisture in soil under bluestem range burned during winter, early spring, and midspring, averaged by foot of soil on various dates in 1959.

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FLOOD PREVENTION STRUCTURE MODEL

Leonard Beck, U. S. Soil Conservation Service design engineer, combined engineering know-how with his model making ability to make this realistic model of a small watershed flood prevention dam.

Prior to working on the model, Beck visited Stony Brook Watershed at Princeton, New Jersey, to make photos of a finished dam and its surroundings. Using the photos and technical engineering knowledge, Beck was able to shape a highly accurate reproduction of a floodwater retarding structure in miniature.

The model, 2 feet square and scaled 1 inch to 50 feet, features two removable sections in the dam. By removing these pieces, viewers can see the core trench, anti-seep collars, cradle, riser and principal spillway. A blue plexiglas area behind the dam marks the normal water level. A clear plexiglass sheet marks the flood pool level. The model is made of light-weight styrofoam and is easily portable by one man when a lid is placed over it.

Leonard Beck, design engineer, points to upper end of the flood pool on his flood prevention structure model. Removable sections show interior structural design.

Post-Hole Tree Planting for Stabilizing Gullies

S. J. URSIC

POST-HOLE PLANTINGS are showing ing promise for reforesting Coastal Plain gullies that were formerly written off as impossible.

On a large acreage in northern Mississippi, erosion has removed the soil and cut through to substrata of compact, often cemented, sands, clays, and sandy clay Coastal Plain deposits. These areas are principal sources of damaging sediment. Many of them will not support even the native pioneer plant species.

The inadequacy of ordinary methods for establishing trees or other vegetation on these eroded sites has long been recognized. Plantings in soil-collection trenches and post holes have shown promise,[1] but heretofore high labor costs have made such techniques impractical. With the development of power diggers, however, hole plantings may be entirely feasible.

[1] Meginnis, H. G. 1939. *Soil-collecting trenches as substitutes for temporary check dams in reforesting gullies.* Jour. Forestry 37: 764-769, illus.

S. J. Ursic is stationed at the Oxford Research Center, Southern Forest Experiment Station, United States Forest Service. This Center at Oxford, Mississippi, is maintained in cooperation with the University of Mississippi.

During the spring of 1956 two agencies of the U. S. Forest Service—the Oxford Research Center and the Yazoo-Little Tallahatchie Flood Prevention Project—cooperated on a study of post-hole plantings of loblolly pine on some of the adverse gully sites in 12 counties in northern Mississippi. This paper reports third-year results.

Study Details

The study was confined to gullies and areas of severe sheet wash. The plantings were on compact Coastal Plain soils except in several of the westernmost counties where loess parent materials were exposed. Slopes ranged up to 30 percent. On such sites the usual treatment is to plant on soil accumulated by brush dams seeded to African weeping lovegrass, on sediment deposits in natural depressions, or on the soil from caved banks. On the study area, such spots were too few to permit establishment of enough pines to prevent erosion.

In each of 12 counties, three blocks were planted to loblolly pine. Each block was composed of three treatment plots each 18 feet square. Nine 1-0 loblolly pine seedlings (3 rows of 3 seedlings) were planted within each plot at a 6- by 6-foot spacing —a total of 972 seedlings. Three treatments within each block were randomly assigned: (1) post hole with mulch, (2) post hole without mulch, and (3) mattock planting without mulch (control treatment).

Six-inch holes were dug to a depth of 24 inches with a back-pack gasoline-powered "Little Beaver" digger.[2] The holes were refilled with the nearest approximation of topsoil that remained in the vicinity. On the mulched plots, loose hay or straw was placed to a 4-inch depth in a 12-inch radius around each seedling. The mattock holes were refilled with the original materials.

All seedlings were grown at the same nursery. Those planted in each county were obtained from a single bale. All installations were completed between February 8 and March 13, 1956, and were protected from grazing.

Results

After three years, survival in post holes averaged 81 percent, despite general June-September rainfall deficiencies of up to 10 inches during the first growing season (table 1). In contrast, survival of all 1956 flood-prevention plantings in northern Mississippi averaged 58 percent after the first year. Seedlings in post holes also made superior height growth, especially those that had been mulched (figure 1).

TABLE 1

Average Survival and Height Growth of Loblolly Pine Under Various Planting Treatments After Three Growing Seasons.

Treatments	*Survival*	*Weighted height growth*
	Percent	*Feet*
Post hole with mulch	86	2.7
Post hole without mulch	76	1.9
Mattock	66	1.4
Average	76	2.1

Figure 1. All pines in this photograph are 3 years old. Those on the left were planted with mattocks. The tall ones in the right background were set in post holes.

Statistical tests indicate that the survival and growth differences between the hole and the mattock treatments, and between the mulched and unmulched hole treatments, are highly significant.

Survival and growth were quite variable among the 12 counties. Survival ranged from 36 to 95 percent and growth from 1.2 to 3.0 feet. These differences were not unexpected, for the study encompasses variable site conditions, several geologic formations, and a wide geographic area. Survival and growth generally increased from west to east, but this trend was confounded with the considerable variation in rainfall.

[2] Details concerning this machine can be obtained by writing to the editor of the JOURNAL.

Survival also varied among the three treatments. Survival of seedlings planted in post holes and mulched ranked first in 8 of the 12 counties and last in 1 county. Survival of mattock-planted seedlings was poorest in 7 counties and best in 3. In 2 of the 3 counties in which mattock-planted seedlings had the best survival they also had the best height growth, an indication that the sites in these counties were not as severe as elsewhere.

Seedlings planted in holes developed very sturdy stems. In one county, stem diameters at the groundline averaged 0.35 inch for mattock-planted seedlings, 0.97 inch for post-hole-planted seedlings, and 1.15 inches for trees planted in post holes and mulched.

The power-driven augers kept planting costs within reasonable bounds. On moist sites, a two-man crew could dig 6-inch holes, 24 inches deep, at the rate of one per minute.

Regular spacing of planting holes is not recommended. Careful location of holes with regard to moisture and sediment characteristics can improve seedling performance. Digging and refilling holes in advance allows the soils to settle before the planting season. To aid relocation, holes can be marked with a stick or painted wire pin.

Spot mulching the post holes is recommended on the basis of this study. The mulch probably improved moisture conditions, and it also held soil in place around the seedling and trapped additional sediment.

WINTER PLANTING COASTAL BERMUDAGRASS

T. H. ROGERS

COASTAL BERMUDAGRASS has been widely accepted as an outstanding forage plant in the South. Since the grass is a hybrid and practically sterile, it must be propagated vegetatively. Experience has shown that it is more difficult to establish Coastal bermudagrass in the Georgia Piedmont than in the Coastal Plain area. Part of this difficulty results from the inability to work the heavy Piedmont soil when the moisture content is high. This usually results in planting it after cotton, corn and other summer crops have been planted. At this time of the year winter moisture is becoming short and temperature and evaporation are increasing. Experience has shown that it is futile to set Coastal bermudagrass unless soil moisture is adequate. Moisture supply is quite unpredictable during late spring and summer.

An experiment was conducted at the College Experiment Station, Athens, Georgia, to determine the survival of Coastal bermudagrass set during the late fall, winter, and early spring months when soil moisture is usually ample. The grass was set on a Cecil sandy loam soil each month beginning in November and ending in April. An attempt was made to set the grass as near the middle of each month as possible. The experiment was conducted during the years 1956-57, 1957-58 and 1958-59. Each year the grass was set following the harvest of a summer crop.

All soil preparation was completed prior to November 15. Freshly-dug sprigs were used for each planting and these were set by hand approximately three inches deep with a small portion of the sprig protruding above the surface of the soil. Each plot consisted of three rows 25 feet long and three feet apart. Twenty-five plants were set in each row. A randomized block design with four replications was used and this gave a total of 300 sprigs set at each planting. Plant survival was determined by count after growth started in the spring.

T. H. Rogers is head of the department of agronomy at the University of Georgia, Athens, Georgia.

Results

Percentage survival for each month during the three year period is shown in table 1. Survival during the winter of 1956-57 was good to excellent, increasing as the date of planting progressed. Plants surviving from early and mid-winter setting were forming runners at the time the April planting was made. Except for November (table 2) temperatures during this period were above normal.

During 1957-58 and 1958-59 temperatures were below normal most of the time. On January 19, 1958, just after the January planting, the temperature was 11 degrees below normal. Plant survival from this date of planting was only 6 percent. Temperatures immediately following the December 1958 and January 1959 plantings were 14 and 22 degrees below normal, respectively.

At this location, survival of winter-set Coastal bermudagrass appears to be determined by temperature. During the first year of the experiment, average plant survival for the six months was 85 percent. With normal spacing an 85 percent stand should give good coverage during the first growing season.

During the second and third years of the experiment, with temperatures below normal, survival was 32 and 36 percent respectively. As an average of the three years approximately one-third survival was obtained from plantings made in November, December and January. February planting resulted in approximately 50 percent survival and of March and April plantings almost 75 percent survived.

TABLE 1

Percentage Survival of Coastal Bermudagrass Sprigs Set at Various Dates on Cecil Sandy Loam, Athens, Georgia

	Month Set						
Year	*November*	*December*	*January*	*February*	*March*	*April*	*Average*
1956-57	74	84	80	89	90	94	85.2
1957-58	20	25	6	22	58	63	32.3
1958-59	14	9	18	49	61	63	35.7
Average	36.0	39.3	34.7	53.3	69.7	73.3	51.1

TABLE 2

Average Minimum Temperatures[1] for Specified Months of 1956-59 and the Normal Minimum, Athens, Georgia

Year	*November*	*December*	*January*	*February*	*March*	*April*
1956-57	38.8	42.9	36.8	43.5	41.5	51.7
1957-58	42.6	33.9	29.0	26.0	38.1	47.6
1958-59	43.9	29.8	29.5	37.2	37.4	49.9
Normal	40.6	35.5	34.8	35.9	40.8	49.3

[1] Degrees Fahrenheit

Mold Inhibition in Coastal Bermudagrass Pellets

A. M. HYSON

COASTAL BERMUDAGRASS, a hybrid well adapted to growth in Southern States, has seen rapid development since its birth in the 1930's at the University of Georgia's Coastal Plain Experiment Station. The wide acceptance of this plant material in the South has been triggered by the need for a high quality, locally grown forage as a source of vitamins, minerals, and protein in mixed feeds as well as a vegetative measure for soil erosion control.

Properly harvested bermudagrass may contain up to 19 percent crude protein and can replace alfalfa meal on a pound-for-pound basis as a source of minerals and of vitamin A equivalent in the form of carotene. Yields can be quite good—up to 13 tons per acre—because of an almost linear response to nitrogen fertilization.

A forage in the form of hay is bulky, thus difficult and expensive to transport and store. For this reason, several processors in Georgia and South Carolina are developing ways to dehydrate and pellet bermudagrass primarily for use in poultry feeds. An even larger potential market for pellets exists in cattle feeds, where the high protein content of the grass may be used to advantage. Extensive studies on this phase of pellet utilization are under way at the University of Georgia's Coastal Plain Experiment Station, as well as at many other locations.

Because of the seasonal nature of grass harvesting, pellets must be stored as long as six months for year-round use. This extended storage period creates a serious problem—that of mold development in stored pellets. Mold spores which carry through the pelleting operation or which contact the pellets during handling and storage will germinate when temperature and moisture conditions become favorable. Molds utilize the pellet nutrients in their own metabolism, with the production of heat and odoriferous end products, thus adversely affecting both the nutritive value of pellets and their palatability to livestock.

Coastal bermudagrass pellets can be produced with a moisture content low enough to prevent mold development, but the moisture level may rise during storage for two reasons: (1) Temperature fluctuation in a large storage area may cause moisture migration and create favorable conditions for mold growth in portions of the stored pellets. (2) Moisture pick-up from the atmosphere is rapid under high humidity conditions.

Data in table 1 demonstrate the speed and extent of moisture pick-up by 10 percent moisture pellets (one-half-inch layer) when exposed to air of varying humidities under static conditions. The mold-free life of the pellets (days for mold to develop) at 90 degrees Fahrenheit is given for the moisture levels corresponding to three days exposure to air at the indicated relative humidities. From these data it is clear that in the absence of a mold inhibitor, the moisture level of the pellets must be maintained below approximately 11 percent if three months or more of mold-free storage is required during warm weather. This may be difficult if humidity is high.

Experience with stored pellets in the South indicates that moisture levels of 12 to 15 percent may be common after pellets have been exposed to the atmosphere for several days.

Fortunately, sodium propionate, a mold inhibitor which has been used successfully by some segments of the feed industry, has also proved to be very effective in controlling mold in bermudagrass pellets. A general review of the performance of sodium propionate in a wide variety of feedstuffs has been published recently.[1] Performance data for sodium propionate in bermudagrass pellets are summarized in table 2.

These results show that 0.35 percent of sodium propionate (seven pounds per ton of pellets) will maintain pellets containing 15 percent moisture in a mold-free condition for six months or more at 90 degrees F. Less inhibitor is required at lower moisture levels, lower temperatures, or for storage periods appreciably shorter than six months. The inhibitor may be added conveniently to the dried and chopped grass during the pre-pelleting operations. It may also be applied to the surface of the pellets with equally good results. Sodium propionate can be used as a mold inhibitor without reservation, since it is harmless to fowl or animals, and is completely metabolized in the animal body.

[1] Hyson, A. M. 1960. *Reports of research on levels of sodium propionate for feedstuffs preservation.* Feedstuffs 32(26).

TABLE 1
Moisture Increase in Coastal Bermudagrass Pellets Under Various Relative Humidity Readings.

Percent Relative Humidity	*Moisture Content After Indicated Time*					*Days of Mold-free Life at 90°F.*
	Starting	*1 day*	*2 days*	*3 days*	*4 days*	
72.5	10	11.3	11.5	11.5	11.5	65-90
79.0	10	13.0	13.5	13.6	13.8	15-25
84.0	10	14.0	15.1	15.6	15.8	5-10
88.0	10	16.2	19.0	20.0	—	2-3
90.0	10	16.7	21.5	22.4	—	2-3

TABLE 2
Mold Inhibition Effects of Sodium Propionate in Pelleted Coastal Bermudagrass.

Percent Moisture in Pellets	*Percent Sodium Propionate*	*Days of Mold-free life at 90°F.*
12	none	68
12	0.1	greater than 180
13.5	none	18
13.5	0.1	75
13.5	0.2	greater than 180
15	none	6
15	0.2	85
15	0.35	greater than 180

Dr. A. M. Hyson is with the research division of the Industrial and Biochemicals Department of E. I. du Pont de Nemours and Company, Wilmington, Delaware.

AUDIO-VISUAL AIDS

Chart: Growth of a Tree. 25" x 35", four colors. American Forest Products Industries, Inc., 1816 N Street, N.W., Washington 6, D. C. (Single copies free.)

This chart shows how a tree grows through the seed, seedling, and sapling stages to maturity. Some natural enemies of trees are shown and the relationship of forest management to tree growth is explained.

Filmstrip: The Miracle of Water. U.S. Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

This filmstrip is acompanied by an illustrated script booklet describing the pictures in the filmstrip. Copies of the booklet are available separately. The filmstrip describes progress in making arid areas of western United States habitable through the development of dependable water supplies. Photographs include some of the major projects of the Bureau of Reclamation—Hoover Dam, Grand Coulee Dam, and Shasta Dam—and depict the multiple-use concept of water resource development for municipal, industrial, irrigation, recreation and other uses.

Suggestions for Contributors

THE JOURNAL OF SOIL AND WATER CONSERVATION is a *technical* and *professional* journal, as distinguished from a strictly *scientific* publication on the one hand and an *educational* or popular magazine on the other.

THE JOURNAL seeks "to advance the science and art of good land use." Manuscripts published must show a definite relationship to the conservation, use and management of land and water resources. The aims of the JOURNAL are to:

- *Inform* readers of new advances in subject matter bearing upon soil and water conservation; inform readers of useful techniques, methods, equipment, tools, or devices of value in conservation work.
- *Record* original information in the specialized field of land use and conservation.
- *Stimulate* creative thinking and encourage investigations of unsolved problems and use of improved procedures.
- *Evaluate* information and ideas in relation to good land use and conservation.
- *Summarize* and organize significant information on topics relevant to the science and art of good land use.
- *Discuss* and debate questions on philosophy and public policy in the field of land and water use and conservation.

MATERIAL appropriate for JOURNAL articles would include:

1 Information based on recent research results, field observations, or experience in the specific field of land use and conservation.

2 Interpretation or application of information from other specialized fields, including economics and the social sciences, to the problems of land use and conservation.

3 Description and explanation of new or improved techniques and field practices.

4 Presentation and discussion of new philosophy or policies in conservation.

5 Discussion of controversial questions and issues of wide significance.

6 Reviews of pertinent and important information on particular topics within the JOURNAL's subject matter field,

AN AUTHOR of a JOURNAL article need not be a member of the *Soil Conservation Society of America*. The author is responsible for the accuracy and validity of all statements made in a published manuscript and it is assumed that all clearance necessary is secured prior to submission of a manuscript to the JOURNAL editor. Normally, papers published elsewhere will not be considered by the JOURNAL.

MANUSCRIPTS should be typed on one side only of a good grade of white paper. In addition to the original, two carbon copies should be submitted. The entire manuscript, including footnotes, references cited, figure captions, and any quotations should be double-spaced.

As a general rule a manuscript should not exceed ten pages in length for with the addition of one or two tables and one or two figures this makes about four printed JOURNAL pages.

SPECIFIC suggestions to authors include attention to the following details:

- Style of writing—Use a clear, expository style suitable to the subject matter. Every article should be readily understood by readers not trained in the writer's technical specialty.
- Organization—Follow a logical organization that effectively conveys the meaning. A short (25-50) word summary statement or significant message might serve in some cases as a good beginning point for a paper. Use subheadings judiciously. Technical articles should have a concise summary that clearly states significant information introduced.
- Footnotes—Number them consecutively throughout the manuscript; only manuscript text material should be footnoted in this manner; tables are footnoted as individual units.
- References cited—List these at the end of the text in alphabetical order by author. After numbering them in order, key them to the text by the appropriate number in parentheses. Unpublished items are not listed as a reference.
- Charts or tables—Material that is presented in the form of a chart or table should not be duplicated in the text material.
- Author biographical information—Give this in a separate paragraph on the first page and set apart by rule lines from the text.
- Illustrations—Photographs for half-tone reproduction should be glossy prints at least 5 x 7 inches in size with good dark and light contrast. Prepare drawings and graphs with India ink on heavy white drawing paper. A good size drawing is twice that desired in the reproduction made in the JOURNAL. Keep all material in proportion. It is not desirable to have lettering or numbers in a finished engraving smaller than the type-size in the body of an article, thus if the figure is to be reduced in size make certain the printing used is of adequate size.

MAKE SURE that photographs and drawings are well protected with cardboard when submitting them to the JOURNAL. Include special information to the editor in a letter of transmittal. Write today for your copy of the complete "Editorial Guidelines and Suggestions to Authors"; it contains detailed suggestions and instructions for preparing and submitting manuscripts.

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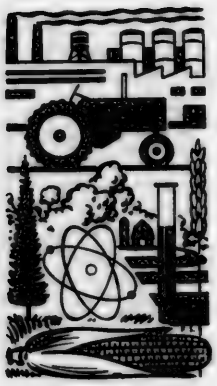


INDUSTRY NEWS

Write for Information
To secure additional details about products and processes shown in this section send a letter to: Editor, Journal of Soil and Water Conservation, 838 Fifth Avenue, Des Moines 14, Iowa.

ROTARY SCYTHE MOWER

A major change in hay mowing machinery design is claimed by The Mathews Company with the introduction of its new "M-C Rotary Scythe." This machine combines a power driven horizontal rotor with 24 hinged scythe blades, a free-turning roller and an adjustable crimping shield.

Mowing a 6 foot width, the front roller bends the hay forward so the curved scythe blades can clip stems at their base. The plants are lifted up, "butts first," with the leafy parts remaining in contact with the roller to prevent further cutting.

HAND-AUGER LIFTER

A tool for lifting hand earth-augers without twisting from depths up to 20 feet is being manufactured by the Daniels Company. The model shown is for a 1¼" auger. A smaller model designed for a ¾" auger and without wheels is also available.

SPRAY MULCH

"Soil-Set", a new elastomeric emulsion concentrate spray mulch, produced by Alco Oil & Chemical Corporation, has recently been marketed. The new spray provides protection against wind and water as it forms a web-like, non-water soluble coating which permits irrigation of the seeded area.

According to the manufacturer the product is harmless to humans and animals. It can be applied with any conventional sprayer or even an ordinary sprinkling can. "Soil-Set" has been found to increase seed germination and after grass begins to grow the material decomposes and washes into the ground. It is available in several colors and in quantities as small as one gallon.

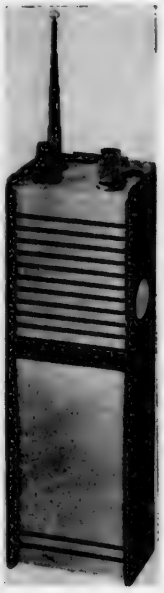
A technical 8-page brochure describing studies, tests, and applications of the product as well as an explanation of how it works is available free of charge.

WATER CONTROL DEVICE

A working model of United States Steel Product Division's new galvanized steel water control device is put through its paces at Utah State University's hydraulics laboratory. Now being field tested, this device can be assembled into a large number of sizes and shapes to form: a. diversion structures, b. check gates, c. drop structures, and d. field turn-outs. It was designed by researchers at the university under a grant from United States Steel.

LAMINATED MAPS

Latest full-color Rand McNally maps permanently encased in clear Railite high-pressure plastic laminate have recently been introduced by the Kenmore Sales Company. Maps of the world and the United States are framed in walnut; they have a washable surface which can be marked with crayon and cleaned with a cloth. A 32" x 44" U. S. map, complete with frame, retails for $25.00

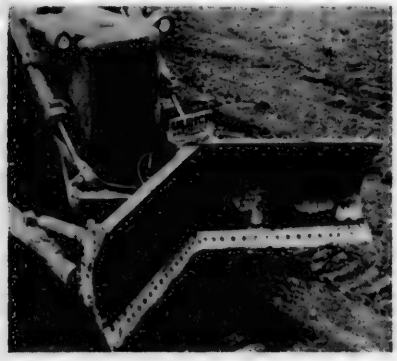


PORTABLE RADIO

A portable two-way farm radio has just been developed by the Radson Engineering Corporation. According to the manufacturer this small battery operated, transistorized unit with collapsible whip antenna can be used indoors, outdoors, or in moving vehicles. It operates on any citizens' band channel and requires no license for operation.

NEW BULLDOZER TOOL

The "Varidozer," a new product of the Ulrich Manufacturing Company, has many useful blade positions. The blade can be changed from a straight bulldozer blade to an angle blade, forward "V", reverse "V", tilt blade, or any variation in between. The blade can also be tipped forward or back in all positions. The vertical hinge in the center permits control of the blade by two hydraulic push arms and two hydraulic tilt cylinders.



SEEDED GRASS BLANKETS

Ideally suited for high erosion hazard spots, a seeded grass blanket known as "Troyturf" is now available from the Troy Blanket Mills. The seeded blankets consist of a 16-ounce mat of jute, a bottom layer of specialized paper, seed, fertilizer, Ph control, Vermiculite, and organic mulch.

The 54-inch wide blankets can be easily rolled out and placed. Watering mats the material to the soil and no additional seeding is necessary. Any combination of seed, fertilizer, moisture control agents, etc. can be used for specific locations.

FENCE BUILDING MACHINE

A fence building machine, dubbed the "Fury Fencer" has been developed by U. S. Steel Corporation to help cut the cost and labor of erecting wire fences. Two men can operate this tractor-drawn machine which can put up woven or barbed wire fence and combinations of both on any terrain where the tractor can be driven safely. It can drive steel or wood posts solidly into the ground, unroll the wire and stretch it to proper tension, all in a one-pass operation.

CHAIN SAW ADAPTATIONS

A new lightweight, easily portable power earth drill has been placed on the market by the McCulloch Corporation. The company also announces that is has introduced an improved power brushcutter and an all new weedcutter. All of these new tools may be purchased as individual units or as attachments for McCulloch chain saws.

MOISTURE GAGE

The Irrigation Engineering Corporation has announced the production of a new instrument for determining the amount of moisture in soil. The "Soilmoist" gage shown is reported to give very accurate measurements of soil moisture at the root zone. The sliding scale tube makes quick readings possible. The gage is manufactured in lengths beginning at 6 inches and in increments of 6 inches up to the length desired.

Moisture passes in or out of the porous cup at the bottom of the gage as soil moisture conditions vary. Air at the top of the scale tube is the gaging means. A new "Junior" edition of the gage, ¼" in diameter and 5½" long, is now being produced for use with potted plants.

VALUABLE BOOKLETS

"Basic Estimating" is the title of a new 75-page, practical handbook for earth-moving contractors recently completed by the Construction Equipment Division of the International Harvester Company. This valuable work is presented in five sections: "Equipment Selection," "Estimating Hourly Production," "Estimating Fixed and Operating Costs," "Estimated Production of Machines," and "Reference Data." The last section is a veritable "gold mine" of easily accessible information. This book is available at International Construction Equipment distributors at a nominal cost.

"Soil and Water Conservation Pays Dividends," another new publication of the International Harvester Company, is a 24 page well illustrated booklet providing much basic information about conservation of land and water. It is available at local International Harvester farm equipment stores.

SS-13 MOVES DOWNSTREAM IN SOUTH CANAL DURING 1958 TREATMENT

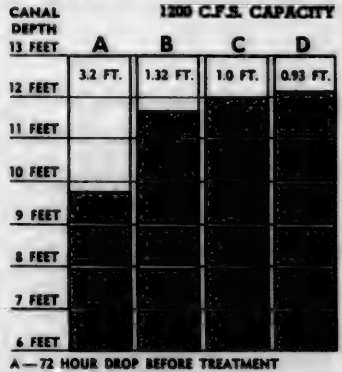
SS-13 SEAL IN SOUTH CANAL STRONGER AFTER TWO YEARS

In December 1958 a 4,000-foot test section of the South Canal, three miles below Granite Reef Dam on the Salt River near Phoenix, Arizona, was treated with Soil Sealer-13 (SS-13). Approximate concentration was 1,000 parts SS-13 per million parts of water. The test was sponsored by the Bureau of Reclamation and the Salt River Valley Water Users' Association. The collection of data was supervised by the Division of Engineering of Arizona State University.

The graph (right) shows test results. SS-13 immediately reduced seepage by 60%. A year later (November 1959) the figure was 68% and two years after treatment (November 1960) seepage savings were 70%.

Experience indicates that SS-13, properly applied, will reduce seepage by from 60% to 90% in irrigation canals and stock tanks.

SS-13 is harmless to animals and humans, but harmful to fish. SS-13 is approved for the Agricultural Conservation Program Service of Arizona.



FOR ADDITIONAL INFORMATION AND EXPERIENCE DATA FILL OUT AND MAIL THE COUPON BELOW.

SS-13

SALES COMPANY

P.O. BOX 4425 • PHOENIX, ARIZONA

Please send me more data concerning Soil Sealer-13 with special reference to its use in.....

.....

Name .....

Address .....

City..... *State* .....

NEWS NOTES

ESSENTIALS OF A SUCCESSFUL EXHIBIT

A successful exhibit like a successful Broadway play depends on a time proven formula. For an exhibit to have a "long run" it must hold its audience from the first glance to the final "curtain call." This formula, perhaps even more important to the exhibit than it is to the play, simply stated is: An interesting subject + a simple plot + plenty of action = a successful exhibit.

To give the formula a test, apply it to any exhibit. As an example, the exhibit prepared by the Adams County Soil Conservation District for showing at the local 4-H fair created a large amount of interest and was used several times after the fair by various organizations to dramatize the subject. In other words, it had a long and successful run.

In creating an exhibit the first and most important decision is to select a subject interesting to the exhibit's viewing audience. If the subject is current and concerns or is closely related to the audience it will be of interest to them. One's total concern is picking a subject that is of vital interest to the audience, therefore, one must forget the rest of the world and its problems for a moment and concentrate only on the interests of a specific audience.

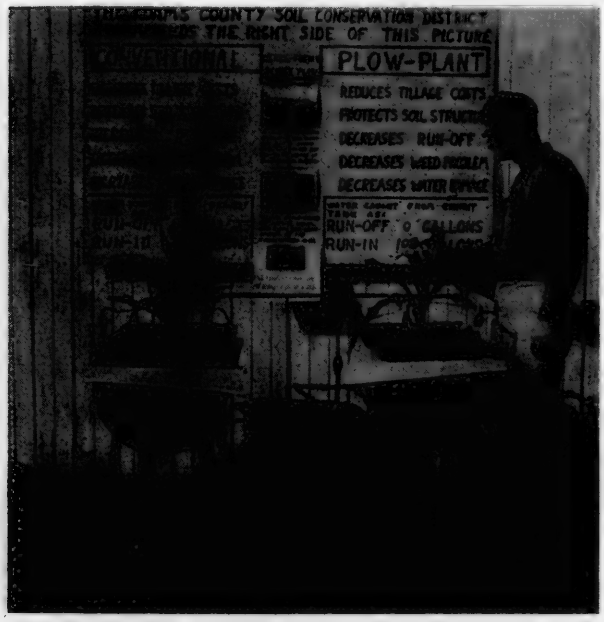
In the case of the Adams County exhibit a wet spring and crop season had created a "natural" for emphasizing the advantages of water "soak-in" on minimum tillage. This, tied in with local demonstration plots, cinched the first part of the formula—a subject that was interesting to the viewing audience.

After the interesting subject has been chosen it is essential that all doubts be removed as to the main theme. One must not cram too many thoughts into one performance—"keep the plot simple." There is a tendency to want to tell "all the story." This is good, except quite often all the story includes parts of several stories and when thrown together into one exhibit adds up to confusion. For instance, the first thought on the Adams County exhibit was to install glass fronts on the soil tanks in order to show a cross section of the soil. This would tend to draw attention away from the soil surface and "soak-in," the main subject of the exhibit. As a result this idea was left out.

The only thing left after one has picked an interesting subject and decided how to keep it simple is to bring it to life. The easiest way to tell whether anything is alive is by the action it demonstrates, thus, to have a live exhibit, give it action. This was accomplished in the Adams County exhibit by using growing corn, running water, and an attendant who had an action job of emptying water buckets and recording the results.

Putting together a successful exhibit is really quite simple. It is one of the most effective means of telling your story to an audience.

—MILTON SPENCE



Milton Spence, work unit conservationist, Soil Conservation Service, Decatur, Indiana, records "run-off" and "run-in" after emptying the water buckets at the exhibit he prepared for the Adams County 4-H fair. The conventional corn planting (left) and plow plant (right) is a tank duplication of local minimum tillage test plots shown on the photos in the center.

DRIVE-IT-YOURSELF TOUR

The Prairie Soil and Water Conservation District at Fowler, Indiana, has planned a drive-it-yourself tour of the district for the benefit of *Society* members attending the annual meeting at Purdue University. *Society* members may make the tour either on the way to the annual meeting or after the sessions close.

Interested individuals may stop at the district office in Fowler, located on U. S. highway 52, just 28 miles northwest of Lafayette, to secure from work unit conservationist, Paul Smith, a copy of the tour map. These maps will also be available at the annual *Society* meeting for those who wish to make the trip later.

THE WONDER OF WATER

The popular type booklet, "Wonder of Water," designed and published by the *Society* in 1957 has now been translated into the Spanish language and is being distributed by the Minister of Agriculture in Venezuela.

Initial work on this project was begun by Warren Murphy, who worked out the details of a Spanish edition of the booklet during a visit to Venezuela last year.

HOWDY RACCOON

The Pensylvania Forestry Association has devised a new figure, Howdy the Raccoon, as a reminder for the Good Outdoor Manners promotion. This symbol will be used to encourage people to protect the natural beauty of the landscape by cautioning them against littering roadsides, parks, and camp grounds, in much the same manner Smokey the Bear has been used to promote fire prevention.

RANGE CONSERVATION STAMP

Soil Conservation Society of America President, Walter C. Gumbel, was recently presented with a souvenir album of the new range conservation commemorative postage stamp. The presentation was made by Fred H. Kennedy, President of the American Society of Range Management, immediately after the annual meeting of that Society. The new color stamp features the "Trail Boss" and his past relationship to new programs that emphasize scientific grassland management.

HOW ARE WE DOING?

SCSA Building Fund Report — June 30, 1961

Chapter	Chapter Pledge	Paid to Date	Other Evidence of Support
Great Plains Region			
El Paso County (Colo.)	$ 250	$ 280.00	
Ark. River Bend (Kans.)	320	171.60	(1)
Bluestem Hills (Kans.)		31.00	
Bob White (Kans.)	145	20.00	
Fort Hays (Kans.)		22.00	
High Plains (Kans.)		51.65	
Manhattan (Kans.)	1,000	288.00	(1)
Pony Express (Kans.)		164.39	(1)
Salina (Kans.)		110.50	(1)
Santa Fe Trail (Kans.)		10.00	
Bozeman (Mont.)		79.00	
Blue-Nemaha (Nebr.)		10.00	(1)
Lincoln (Nebr.)		167.50	(1)
Northeast Nebraska		41.50	(1)
S. C. Nebraska		237.03	(1)
Southwest Nebraska		19.65	
Rio Grande (N. Mex.)	75	202.00	
Border (N. Dak.)		15.00	
Custer (N. Dak.)		209.63	
Big Hunt (Okla.)		22.25	
Central Oklahoma		35.00	
E. C. Oklahoma		102.25	
N. E. Oklahoma		202.32	
Northwest Oklahoma		4.00	
S. C. Oklahoma	100	68.00	
Southeast Oklahoma		13.50	
Southwest Oklahoma		152.00	
Stillwater (Okla.)		55.50	(1)
South Dakota		1,219.25	
East Texas	442	171.50	(1)
Heart of Texas		737.41	(1)
North Texas	50	125.50	(1)
Wyoming		96.00	
North Central Region			
Egyptian (Ill.)	250	88.00	(1)
Northern Illinois	2,600	786.70	(1)
Hoosier (Ind.)		440.75	(1)
Iowa	5,000	3,922.30	(1)
Blue Grass (Ky.)		55.00	(1)
Green River (Ky.)		50.00	
Kentucky Lake	250	175.50	(1)
Lake Cumberland (Ky.)		30.00	
Northern Kentucky		25.00	
Upper Kentucky River (Ky.)		40.00	
Michigan	2,500	696.42	(1)
Minnesota	1,600	505.75	(1)
Show-Me (Mo.)		232.00	
All Ohio	1,000	555.00	(1)
Wisconsin	2,400	665.50	(1)
Northeastern Region			
S. New England (Conn.-Mass.-R. I.)		64.00	
Washington, D. C.	5,000	2,381.42	(1)
N. New England (Maine-N. H.-Vt.)	1,480	142.50	(1)
Old Line (Md.)	1,500	564.00	(1)
Pocomoke (Md.)		100.00	(1)
New Jersey	1,250	1,392.00	(1)
Empire State (N. Y.)	2,000	1,183.00	(1)
Keystone (Pa.)	1,000	236.00	(1)
Wm. Penn (Pa.-Del.)	400	543.50	(1)
Virginia	2,500	966.25	(1)
West Virginia	3,000	2,388.00	(1)
Southeastern Region			
North Alabama		25.00	
South Alabama		193.50	
Central Arkansas	800	903.00	(1)
Ozark Mt. (Ark.)		309.00	
Florida		367.00	
Georgia	5,000	617.50	(1)
Louisiana		159.00	
Mississippi		46.00	
North Carolina	5,000	732.25	(1)
Puerto Rico		52.00	
Western Puerto Rico		10.50	
South Carolina	795	456.55	
Andrew Jackson (Tenn.)	1,000	548.00	(1)
East Tennessee	900	119.50	(1)
West Tennessee	570	212.75	(1)
Western Region			
Arizona		109.50	
California	3,500	1,634.25	(1)
R. N. Irving (Idaho)		140.50	(1)
Nevada		15.00	
Oregon		110.50	(1)
Utah		59.00	(1)
Inland Empire (Wash.-Idaho)		187.50	
Olympic View (Wash.)		31.50	
Canadian Region			
Ontario	1,600	1,333.00	
Other Contributions			
Korea		20.00	(1)
No Chapter Designated		605.50	
Development Fund Board Special Solicitation		1,092.50	
Des Moines Fund Drive[1]		1,500.00	
Transfer of Funds		3,870.00	
Total	$55,277	$38,823.82	43
Interest earned		$ 644.74	
Total on deposit		$39,468.56	
Grand total ([1]additional $1,000 to be paid upon letting of contract)		**$40,468.56**	

(1) Chapter Building Fund Committee Organized

CHAPTER NEWS

Indiana Chapter not only has been busy with preparations for the annual *Society* meeting, but as of July 1 had sold over 56,000 copies of the *Society's* popular type booklets.

Iowa Chapter reports that 52 of the state's 100 soil conservation districts have made a contribution to the *Society's* building fund. On May 26, Area 4 of the chapter held a meeting in Des Moines. Over 80 persons were in attendance. On June 15, Area 3 held a meeting at Audubon, while on June 24, Area 1 held a picnic-meeting.

Utah Chapter cooperated with the Intermountain Section of the Society of American Foresters and the Utah Section of the American Society of Range Management in sponsoring a joint meeting on April 8. Charles W. Townsend, assistant state conservationist, Soil Conservation Service, represented the chapter on the program with his presentation of "Impact of Current Social Trends on Agricultural Lands."

Washington, D. C. Chapter—A chapter committee headed by James Simpson has worked actively this past year in selecting the best soil and water conservation exhibits at each of five area science fairs. This was a continuation of the last 2 years' work by this particular committee, but a new idea added this year was the presentation to winners of outstanding exhibits a certificate of recognition from the chapter.

Another new angle of interest was the cooperation of this committee with the work the Organization of Professional Employees of the Department of Agriculture are doing to promote, encourage and recognize outstanding science fair projects that relate to agriculture.

Kansas State Council of Chapters held their second annual meeting at Hutchison on June 9 and 10. The Ark River Bend Chapter, one of the ten Kansas chapters, was host to over 175 *Society* members attending the 2-day session. Milton Saffry of Dodge City is chairman of the Kansas State Council of Chapters, *SCSA*, this year.

A number of superior papers were delivered and press coverage for the meeting was tremendous, judging from the number of clippings received in the national *SCSA* office.

During the evening banquet, George Jorgenson of the Pony Express Chapter was recognized as the outstanding member of *SCSA* in Kansas during the 1960-1961 year. Named as superior chapter for the year was the Manhattan Chapter.

Olympic View Chapter (Washington) held their annual meeting at Port Gamble on February 10. Professor E. Atkinson presented an interesting and enlightening talk on the history and needs of the soil and water conservation movement. Paul C. Dickey, retiring Soil Conservation Service area conservationist, was honored during the meeting.

Egyptian Chapter (Illinois) presented their Chapter Award—1960 to Mr. George Smith at the regular chapter first quarter meeting on March 10. Smith was cited for his dynamic leadership as a previous chapter chairman and for his unselfish devotion of time and talent to chapter projects.

Louisiana Chapter members gathered 100 strong in Baton Rouge for their first annual meeting February 15 and 16. A varied and vital program was presented. The second day of the session was devoted largely to a panel discussion, "The Necessity for Public Understanding and Support of Efforts to Preserve the Fertility of the Soil."

Oklahoma Chapters will hold their annual meeting November 10 and 11 at Western Hills Lodge. "Residue Appreciation" is to be the theme of the meeting.

Northern Illinois Chapter — Even though an industrial firm may need 65 million gallons of water a day, it can, through various conservation measures, hold consumption from underground water supplies to less than 1.5 million gallons a day. Seventy-two members of the chapter, together with 15 wives and children, learned this during the chapter's summer meeting held at the Caterpillar Tractor Company plant in Peoria. The purpose of meeting was to study industrial water use and conservation.

Caterpillar holds down consumption from underground supplies by taking about 10 million gallons a day from the Illinois River and recirculating it 5 to 10 times. This recirculated water makes up the company's remaining need of 63.5 million gallons, according to Harry R. McNeely, plant engineer for Caterpillar's Peoria facility.

McNeely explained where the firm gets its water, how the water is used and what conservation measures are taken. Following his address, the group toured the company's 70 million gallon settling basin, pumping station and filtration plant.

McNeely pointed out that even though Caterpillar takes in about 11.5 million gallons of fresh water each day (enough to supply a city of a quarter million persons), only about 11 percent is taken from the area's underground water supply. Essentially all the rest is taken from the Illinois River. Except for slight evaporation losses, all of it eventually is returned to the river. Because of the treatment it receives, it is in better condition when it goes back to the river than when it came out.

Underground water is drawn from five company-owned wells. A meter on each records the amount pumped. This information is supplied to state water control boards and agencies, so that those agencies can judge industrial use and conservation of water.

During the tour, C. G. Tohn, utility manager of the Peoria plant, explained that river water is chlorinated both before and after filtering. Alum is added to prevent dirt from penetrating too deeply in the sand filters. The sixteen 25-foot long, 8-foot diameter sand and gravel filters are backwashed every 8 hours to remove accumulated dirt.

When taken from the river, Tohn said, water turbidity runs from 20 to 40 parts per million. For use in the plant, turbidity is reduced to 3-5 parts per million.

C. G. Tohn, Caterpillar's Peoria plant utility manager, explains the use, construction and purpose of the 10.5 acre settling basin to a group of Northern Illinois Chapter members. The pier is for use by members of the company's Rod and Gun Club.

DATES TO REMEMBER

Soil Conservation Society of America Annual Meeting. July 30-August 2. Purdue University, West Lafayette, Indiana.

National Farm Safety Week. July 23-30. Sponsored by the National Farm Safety Council.

Third Annual Western Resources Conference. August 7-11. Colorado State University, Fort Collins, Colorado.

Conservation Education Association National Conference. August 13-16. Montana State University, Missoula, Montana.

1961 Soil Conservation Field Days and National Plowing Contest. September 15-16. Melrose, Minnesota.

American Forestry Association Annual Meeting. October 1-4. Santa Fe, New Mexico.

Society of American Foresters Annual Meeting. October 8-11. Minneapolis, Minnesota.

Resources for Tomorrow Conference. October 22-28. Sponsored by the Canadian government. Montreal, Canada.

Southeastern Water Law Conference. November 8-10. University of Georgia. Athens, Georgia.

For further information concerning any of these meetings please contact *Society* headquarters at 838 Fifth Avenue, Des Moines 14, Iowa.

West Virginia Chapter—The 16th annual chapter meeting will be held September 22-24 at Jackson's Mill. A comprehensive, balanced program has been planned; the cost for a most inspiring and informative weekend is nominal.

Mississippi Chapter has compiled an exemplary bibliography on soil and water conservation in Mississippi. Arrangements have been made to have this distributed to every school in the State through the Department of Education. Attached to a recent newsletter was the talk "Conservation Leadership in the New South," delivered by Dr. Ben Hilbun, chairman of the Mississippi Industrial and Technological Research Commission, at the annual chapter meeting held earlier. A copy may be secured by writing to R. C. Carter, Mississippi Chapter Chairman, Box 610, Jackson, Mississippi.

Wisconsin Chapter held a summer meeting in Madison on July 6. During the morning the group attended the symposium "Weather and the Plant," sponsored by the North Central Branch of the American Society of Agronomy. *Society* President Walter C. Gumbel was the luncheon speaker and William Russell, W. A. Rowlands and J. W. Clark delivered presentations during the afternoon session. The Wisconsin Chapter has developed a useful little membership brochure and a 4 by 9 inch card entitled, "Don't Splinterize, Be Wise and Organize," for use in contacts with potential members.

Southwest Kansas Chapter, recently chartered by the *SCSA* Council, is the newest unit in the 425-member Kansas organization. On the evening of June 8, Executive Secretary Pritchard presented the charter at a meeting in Garden City. Dean Stratton of Ulysses is chapter chairmen and Pat Longly of Garden City is secretary.

NEW AQUATHOL FOR FAST, SAFE CONTROL OF UNDERWATER WEEDS

In just a few days Aquathol can clear ponds and lakes of troublesome underwater weeds . . . without harm to fish or other water life . . . and leave water safe for domestic and recreation uses. Developed exclusively by Pennsalt, Aquathol is easy to apply—effective.

Ask your farm chemical distributor or write Pennsalt Chemicals Corp., Aurora, Illinois; Montgomery, Alabama; Bryan, Texas, or 3239 Mayfair Boulevard, Fresno, California.

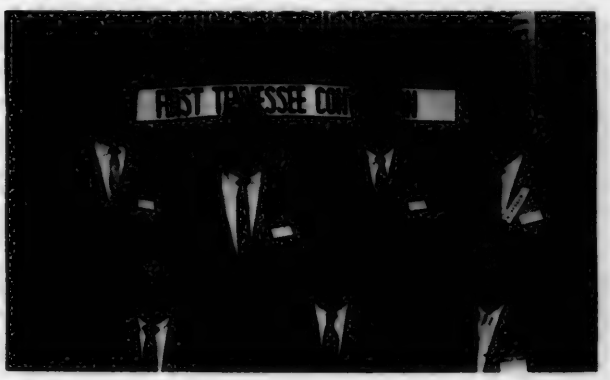
a product of Pennsalt research . . .

AQUATHOL*

*A trade-mark of Pennsalt Chemicals Corp.

Puerto Rico Chapter members took a field trip related to beef production and conservation on mountain lands on June 17. Also planned for the near future is a field trip related to intensive coffee production and conservation on mountain lands.

Officers of the three Tennessee Chapters of the Society pause for a few minutes during the annual meeting. Standing (left to right), Bernard Zellner, vice-president, and Joe Spencer, president of the East Tennessee Chapter. Third from the left is Glenn Elkins, vice-president of the West Tennessee Chapter and on the far right is Theodore Bigger, president of the Andrew Jackson Chapter. Seated (left to right) are A. K. Booher, secretary-treasurer, Andrew Jackson Chapter; R. D. Fisher, president, West Tennessee Chapter, and D. K. Springer, vice-president, Andrew Jackson Chapter.



William Penn Chapter (Pennsylvania) held its spring meeting at the Morris Arboretum on May 22. In the photograph below, Dr. Frank S. Santamour, forest geneticist with the Northeastern Forest Experiment Station, explains to a few of the 80 members and guests who attended, how desirable tree characteristics can be reproduced through vegetative propagation. Dr. Ralph Marquis, director of the Northeastern Forest Experiment Station, and Dr. John Fogg, director of the Arboretum, also participated in the day's program.

SOIL TESTING AIDS CONSERVATION

LaMotte Soil Testing Service is the direct result of over thirty years of extensive cooperative research. All LaMotte Methods are approved procedures, field tested for accuracy in actual plant studies. These methods are flexible, and are capable of application to all types of soil with proper interpretation to compensate for special local soil conditions.

Outfits can be furnished for specific nutrient tests, or in combinations of tests to meet requirements. A copy of the LaMotte Soil Handbook is supplied with each outfit.

Literature and recommendations on soil testing equipment will be sent on request. No obligation.

La Motte

Chemical Products Company

Dept. S&W, Chestertown, Md. U.S.A.

James W. Wallace, president of the Pioneer Hi-Bred Corn Company, Des Moines, Iowa, was elected president of the American Seed Trade Association during the organization's recent meeting in Chicago.

Louis C. Hermel has been named to the newly created position of deputy regional forester, north central region, U.S. Forest Service. His headquarters will continue to be in Milwaukee where he has served as assistant regional forester for several years.

William C. Ackermann, a member of the JOURNAL'S editorial board and chief of the Illinois State Water Survey Division, was named as president of the Section of Hydrology of the American Geophysical Union. He will take office on July 1 and serve the 2,500 member Section as president for a 3 year period.

NEWS OF MEMBERS

Ayers

Harper

Thomas L. Ayers, assistant to the administrator of the Agricultural Conservation Program Service, and **Dr. Verne L. Harper,** assistant chief of the Forest Service, were among the six individuals who received Distinguished Service Awards from the United States Department of Agriculture on May 23. Mr. Ayers was honored for his leadership in the development of the farmer committee administration of conservation of the nation's soil resources. Dr. Harper received the award in recognition of his outstanding direction of research in the Forest Service and for his contributions to international forestry progress.

Eleven *Society* members were among the 93 cited for superior service by the United States Department of Agriculture at ceremonies in Washington, D. C., on May 23. Among those honored for important achievements were **John H. Christ,** SCS, Honolulu, Hawaii; **Harold L. Jenkins,** SCS, Washington, D. C.; **John I. Kincaid,** SCS, Austin, Texas; **Longfellow L. Lough,** SCS, Morgantown, West Virginia; **Robert H. Mills,** SCS, Bucyrus, Ohio; **Harold F. Morey,** FS, Washington, D. C.; **John F. Reynolds,** SCS, Evergreen, Alabama; **Donald E. Sloan,** SCS, English, Indiana; **Nunnally P. Stephenson,** SCS, Temple, Texas; **George M. Tannehill, Jr.,** FS, Winnfield, Louisiana; and **Gladwin E. Young,** SCS, Washington, D. C.

O. W. Bidwell, Manhattan, Kansas, has been named by *Society* President Walter C. Gumbel as a member of the editorial board for the JOURNAL OF SOIL AND WATER CONSERVATION. Dr. Bidwell is professor of soils at Kansas State University and is also soil survey leader for the Kansas Agricultural Experiment Station.

Glenn H. Deitschman, in charge of the Central States Forest Experiment Station's field office in Ames, Iowa, for the past 5 years, has recently been transferred to Spokane, Washington. He will head up Forest Service research on western white pine in the experimental and national forests of the West.

Richard S. Snyder, state conservationist for the Soil Conservation Service in Delaware, retired on April 30. **William R. Ratledge,** who has been assistant state conservationist for watersheds for both Maryland and Delaware, assumed the position previously held by Snyder.

DEATHS

William Fisher and his wife, Hickory Corners, Michigan, were killed in an automobile accident, April 9. Fisher was chairman of the Michigan Chapter, *SCSA* in 1957 and received a Commendation award at the 1960 annual meeting of the *Society*.

Lewis C. French, Milwaukee, Wisconsin, died December 18, 1960. He had retired in 1959 after 34 years of service with the *Milwaukee Journal* as a farm reporter.

Clyde Spry, Des Moines, Iowa, died suddenly of a heart attack on June 15. Mr. Spry was Secretary of Agriculture for the State of Iowa at the time of his death and last year received the Degree of Fellow in the *Society*.

Edward Woolman, Haverford, Pennsylvania, died in late 1960.

L. W. Harvel, Levelland, Texas, died December 14, 1959.

Bruce DeVinny, Acampo, California.

Lee H. Carleton, Stillwater, Oklahoma, passed away in June 1960.

Charles Gotthard, Buckley, Michigan, died April 27, 1961.

Leonard J. Braamse, East Lansing, Michigan, passed away in October 1960. He was extension soil conservationist in Michigan at the time of his death.

J. David Forsythe, Greensboro, North Carolina.

E. J. Fortenberry, Ogden, Utah.

A. W. Showalter, Yorktown, Pennsylvania.

Arthur Courtade, Fort Worth, Texas, killed in an automobile accident on February 17. Mr. Courtade was advisor to the *SCSA* Student Chapter at Texas A. & M. College. Three of his college students were injured in the same accident.

Charles H. Freeman, Meridian, Mississippi, died May 9 after an illness of several months duration. He was a soil scientist and long time member of the *Society*.

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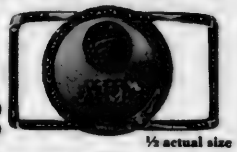

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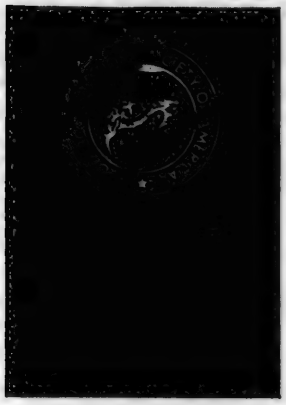

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Soil Conservation Society of America
838 5th Avenue
Des Moines 14, Iowa

William Russell, vice-chairman of the Wisconsin Chapter and assistant state conservationist with the Soil Conservation Service, has been named as one of four employees selected by the Service to attend the seminar, "Management and Development of Renewable Resources," at the University of Colorado. The 9 month session begins in September.

Ralph O. Lewis, who is serving with the International Cooperation Administration in Thailand, has been vacationing in the U. S. for the past few months. He will return to his duties as deputy fruit and agriculture officer in Thailand on August 14.

Wallace E. Akin of Des Moines, Iowa, is the recipient of a Fulbright Scholarship. Dr. Akin and his family will leave New York on August 9 for the trip to Denmark. His headquarters in Denmark will be at the Institute of Geography, University of Copenhagen, Copenhagen.

Lawrence K. Mays, long time Forest Service employee, has been named as the director of the internal audit staff for the Service.

J. P. Kuykendall, assistant state conservationist for the Soil Conservation Service in West Virginia, became state conservationist there upon the retirement of **Longfellow Lough** on June 30.

Tom McGourin, assistant state conservationist for the Soil Conservation Service in Louisiana, has been named as state conservationist in Virginia. **Frank Edminster,** formerly state conservationist there, has joined the Washington office staff of Service as assistant director of the plant technology division.

Stanley A. Cain, Charles Lathrop Pack Professor of Conservation, has relinquished his position as chairman of the Conservation Department of the School of Natural Resources at Michigan State University. During the 11 years he served as department chairman, the program at Michigan State University has enjoyed a reputation for superiority. This summer Cain will participate in the XIII International Phytogeographic Excursion in Finland and Norway. **Lyle E. Craine** has been named as department chairman to succeed Cain.

Peter E. Black received the nation's first doctor of philosophy degree in watershed management at the Colorado State University on June 10. Black will join the staff of Humbolt State College, Arcata, California, where he will teach courses in forest influences and forest and range hydrology. His doctorate program was directed by **Robert E. Dils** and **Bernard Frank,** professors of watershed management at Colorado State University.

Walter C. Gumbel, *Society* President, recently recorded a 3 minute talk on "Fertility Works for Conservation" as a part of a series of recordings by nationally-known leaders in the field of agriculture. This series of programs prepared by the Farm Radio News Service is heard on nearly 1,300 radio stations throughout the U. S.

A. R. Bertrand, vice-chairman of the Hoosier Chapter (Indiana) and a professor in the department of agronomy at Purdue University, has been named as director of the Southern Piedmont Soil and Water Management Laboratory, Watkinsville, Georgia.

(Continued from page 156)

ways by which every citizen may assist the conservation movement.

"The Story of Land", the *Society's* first cartoon type booklet, introduced in 1955, tells briefly about formation of soil and how it has been cared for during the centuries.

"The Wonder of Water" dramatizes the need for water by a local community—in agriculture, in industry, for the municipality, and for the citizens. It outlines the watershed approach to water conservation. A teacher's guide has been prepared for this booklet.

"Dennis the Menace and Dirt" was produced for the *Society* by Hank Ketcham, widely known cartoonist. This booklet tells why soil is important in daily living; the format is the typical "Dennis" style. This publication is now out of print.

"Help Keep Our Land Beautiful" tells of the summer trip of the mythical Webster family who view conservation problems and their solution. It emphasizes the total resource problem and is probably the *Society's* best effort to date. Introduced in late March of 1961 it has already been reprinted. Plans are under way for a teacher's guide to be used with this publication.

Society members will be interested in knowing that total sales of these booklets have amounted to $165,000, while costs have approximated $110,000, leaving the *Society* a net of $55,000. Of this amount $8,600 has been paid to local chapters for their assistance in distribution. Several chapters have also had cooperative agreements with the parent *Society* that have brought them additional income. Chapters use the income from booklet sales to finance their chapter programs and activities.

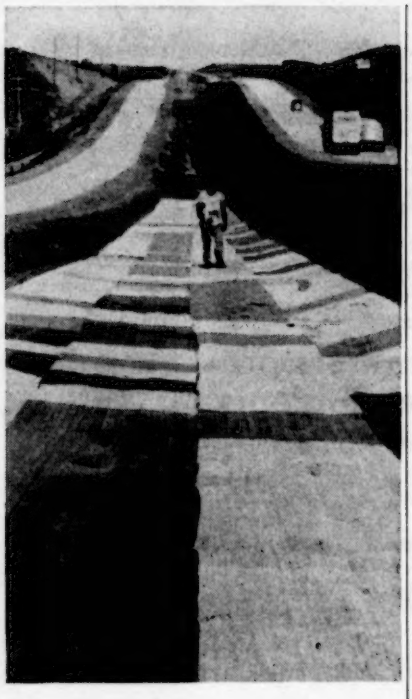
Jack Barrick, formerly of West Virginia, where he assisted the West Virginia Chapter in distributing more than 100,000 booklets, is serving as chairman of the *Society's* committee to work with chapters in planning booklet distribution. Chapters desiring to establish a plan to promote booklet distribution should contact Jack at his present location—20 Victoria Drive, South Burlington, Vermont.

One of the real problems confronting the Des Moines office is the great number of requests from teachers and students for free copies of the publications. Because of the demand, chapters are encouraged to take the lead in finding ways of distribution in their respective areas.

Future plans call for a revision of the booklet "The Story of Land" and for booklets in the areas of wildlife and forestry.

WHILE POPULAR TYPE booklets have been used extensively, the *Society* has not neglected material of interest and value to the member. The *Glossary of Soil and Water Conservation, Our Watershed Resource, Land Utilization, Principles of Water Policy,* and *Snow Surveys* have been published in recent years. The new technical study committees will produce reports of significance to members.

—H. WAYNE PRITCHARD
Executive Secretary



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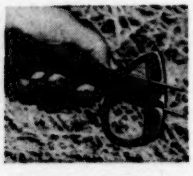

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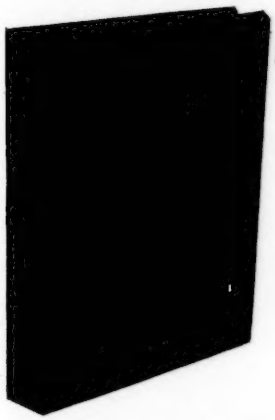

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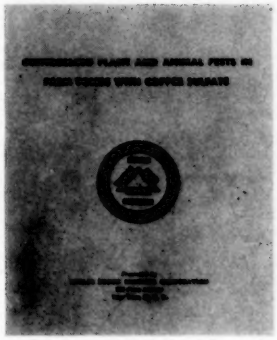
how to overcome plant and animal pests in farm ponds



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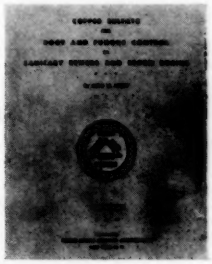

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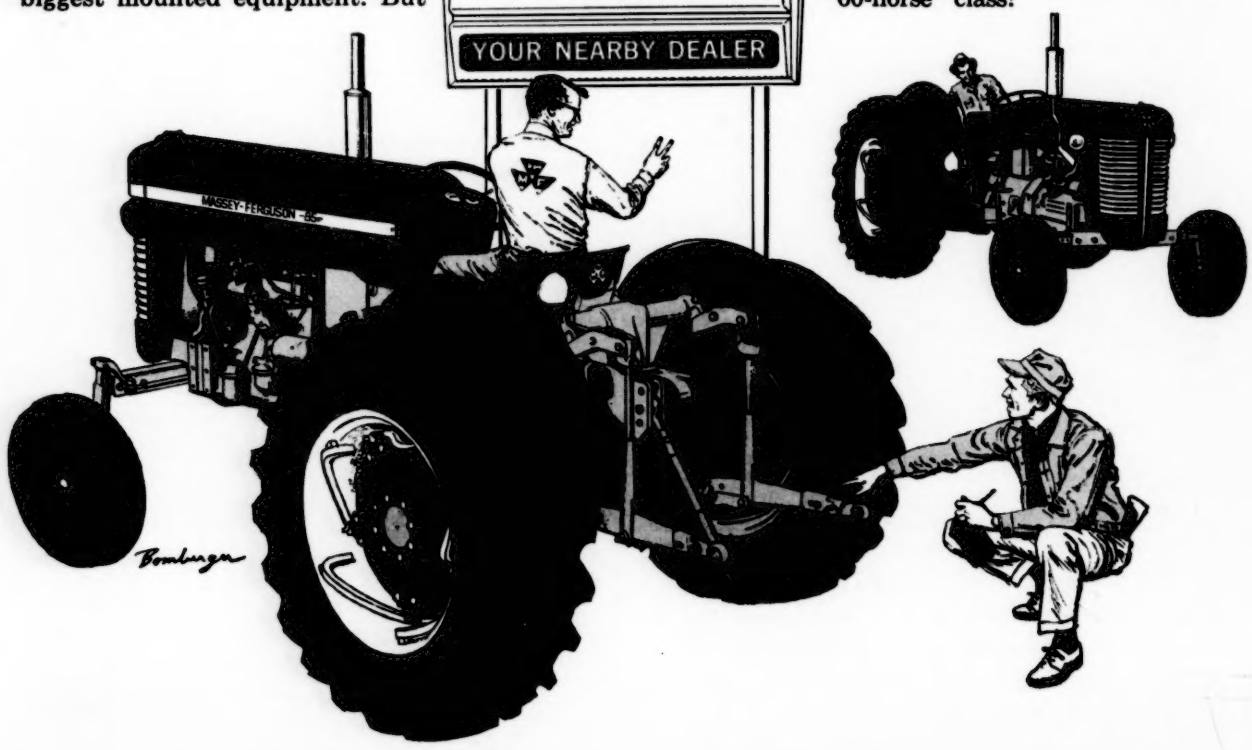

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